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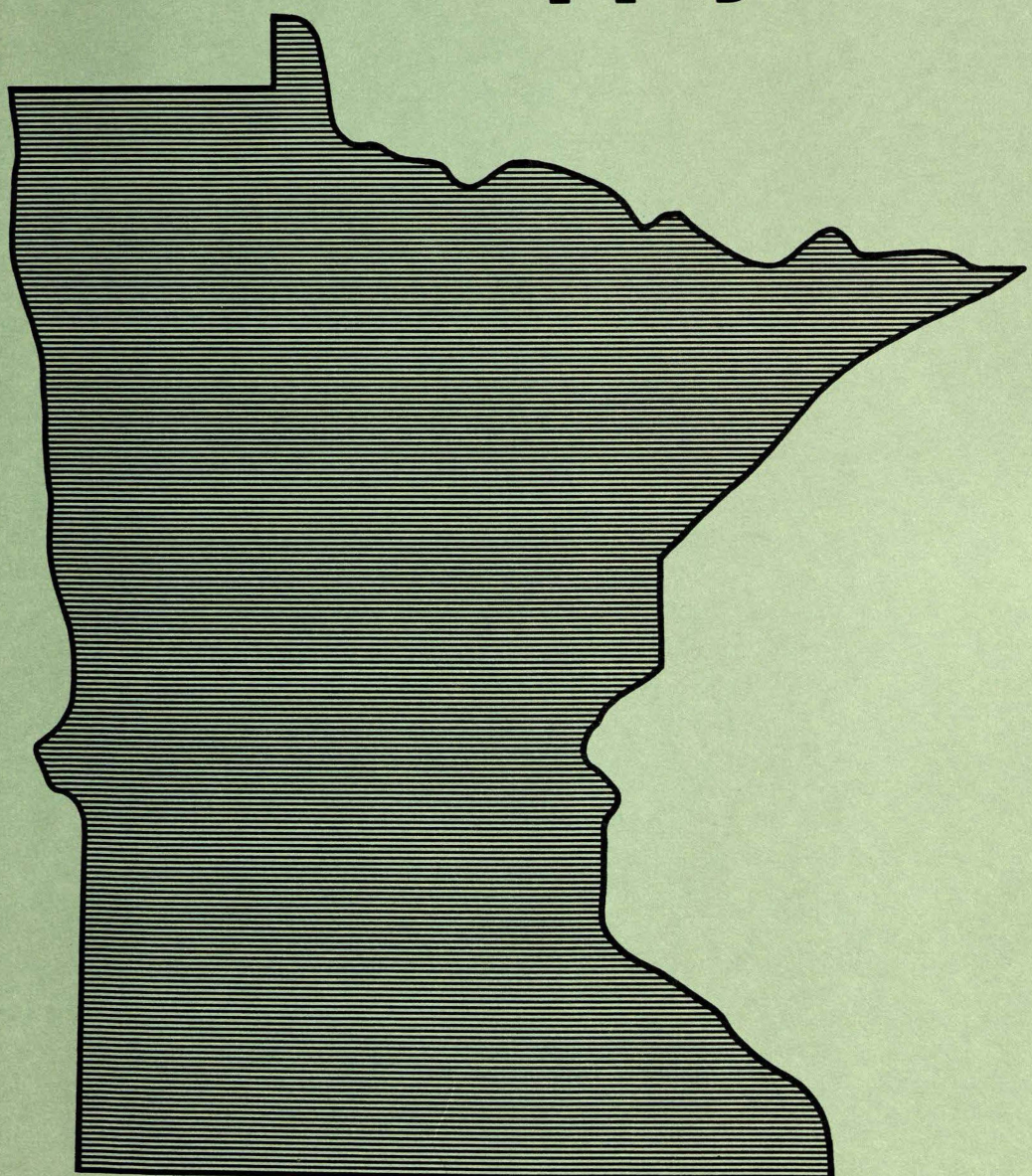
North Central Forest Experiment Station

Resource Bulletin **NC-57**

The Fourth Minnesota Forest Inventory: Timber Volumes and Projections of Timber Supply

John S. Spencer, Jr.



This report includes the most commonly used Resources Evaluation statistics, but other forest resource data can also be provided. Persons requesting additional information from the raw inventory data are expected to pay the retrieval costs. These costs will vary depending on the complexity of the request, from less than $100.00 for a simple request to $2,000.00 for a complex retrieval involving the services of a Resources Evaluation computer programmer. Requests for data will be scheduled to minimize the impact on the Resources Evaluation work unit.

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FOREWORD

Resources Evaluation (formerly Forest Survey) is a continuing endeavor mandated by the Forest and Rangeland Renewable Resources Planning Act of 1974, which was preceded by the McSweeney-McNary Forest Research Act of 1928. Its objective is to periodically inventory the Nation's forest land to determine the extent, condition, and volume of timber, growth, and depletions. This kind of up-to-date information is essential for intelligent forest policies and programs. USDA Forest Service regional experiment stations are responsible for conducting these inventories and publishing summary reports for individual States. The North Central Forest Experiment Station is responsible for Resources Evaluation work done in Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, eastern South Dakota, and Wisconsin.

Fieldwork for the 1977 Minnesota Forest Survey was begun in July 1974 and was completed in July 1978. Reports on the three previous surveys of Minnesota's timber resource are dated 1936, 1953, and 1962.

The 1977 Minnesota survey data have been adjusted to take into account the expansion of the reserved portion of the Boundary Waters Canoe Area (BWCA) in the fall of 1978. The adjustments were made so that the data are as current as possible.

The North Central Station has published similar Resource Bulletins reporting statistical highlights and detailed tables on the timber resource of the four Minnesota Survey Units.

More accurate survey information was obtained during the 1977 survey than otherwise would have been feasible because of intensified field sampling. This was made possible by additional funding and manpower provided the North Central Station by the Minnesota Legislature through the State's Department of Natural Resources. The DNR also assisted in a canvass of the State's primary wood-using plants to help estimate the quantity of timber products harvested in Minnesota.

Aerial photos used in the Minnesota Forest Inventory were furnished by Boise Cascade Company, Chippewa National Forest, Lake County Land Commissioner's Office, Minnesota Department of Natural Resources, Superior National Forest, USDA Agricultural Stabilization and Conservation Service, and USDI Bureau of Indian Affairs.

The fourth Minnesota inventory was a team effort. Burton L. Essex, Resources Evaluation Project Leader, directed the inventory and, along with Jerold T. Hahn, designed it and planned the sample selection. Arnold J. Ostrom supervised the aerial photo interpretation work and the field data collection. Photo interpretation was performed by Alexander Vasilevsky, Ronald L. Hackett, and Alan Hendricks. James E. Blyth designed and supervised collection of timber products output and timber removals data and made 30-year projections of removals. Gerhard K. Raile, W. Brad Smith, and Mark H. Hansen, with support from Patsy E. Latourelle, Patrick J. Peine, Joan Stelman, Jean A. Smoley, and Carol Weist, processed the data and generated summary tables. Pamela J. Jakes and John S. Spencer, Jr., checked the consistency of the fourth Minnesota inventory with the third. Spencer made the 30-year projections of the timber resource except for removals. Smith and Jakes evaluated treatment opportunities and estimated predicted yields from selected cutting prescriptions in the State. Peine prepared final tables and Mary Jean Hanson typed the manuscripts.

HIGHLIGHTS

Volume

- Volume of growing stock on commercial forest land increased from 9.4 to 11.5 billion cubic feet between 1962 and 1977, a 21-percent gain.
- Softwood growing-stock volume crept up 3 percent between surveys, but hardwood volume jumped 32 percent.
- Sawtimber volume rose from 14.9 to 24.6 billion board feet between surveys, a gain of 65 percent.
- Average growing-stock volume per acre increased from 613 to 836 cubic feet (7.8 to 10.6 cords) between surveys.
- Total volume in 1977 (13.0 billion cubic feet) included 1.2 billion cubic feet of rough and rotten trees, 0.2 billion of short-log trees, and 0.1 billion in salvable dead trees, in addition to the 11.5 billion in growing-stock trees.
- The Northern Pine Unit contained the largest volume of growing stock (5.0 billion cubic feet), followed by the Aspen-Birch Unit (4.5 billion).
- Nonindustrial private parties owned 39 percent of the growing-stock volume.
- Aspen accounted for 3.4 billion cubic feet — 30 percent of the growing-stock volume.
- Four-fifths of the growing-stock volume is in trees 12 inches or less in diameter.
- Seventy percent of the growing-stock volume is in stands aged 31 to 70 years.
- Three-fourths of the sawtimber volume is in grade 3 logs.

Stand Conditions

- Net annual growth of growing stock declined from 364 to 349 million cubic feet from 1962 to 1976, a 4-percent drop. Softwood growth increased by 12 percent, but hardwood growth fell by 11 percent between surveys.
- The growth rate was 3.0 percent of inventory in 1976. The softwood growth rate (3.4 percent) was somewhat higher than the hardwood rate (2.9 percent).
- The average net annual growth per acre remained nearly constant between surveys — 24 cubic feet in 1962 and 25 cubic feet in 1976.
- Mortality of growing-stock trees amounted to 142 million cubic feet in 1976, 1.2 percent of inventory.
- Disease caused 57 percent of the 1976 mortality.

Timber Use

- Timber removals from growing stock increased from 146 to 194 million cubic feet between 1962 and 1976, a gain of one-third. The increase is due entirely to hardwoods.
- Aspen removals increased from 46 to 73 million cubic feet between surveys.
- Roundwood products accounted for 70 percent of total removals, other removals for 28 percent, and logging residues for 2 percent.
- Pulpwood made up two-thirds of the volume removed for roundwood products.
- Private lands yielded 62 percent of the removals volume, but contained only 45 percent of the inventory.
- A comparison of 1976 removals with predicted yields from selected cutting prescriptions suggested that removals could be substantially higher.

Projections

- The low removals option projection shows inventory increasing from 11.5 to 15.3 billion cubic feet between 1977 and 2007, a 33-percent gain. Growth is projected to approach removals, but to remain higher than removals throughout the period.
- The high removals option shows inventory rising from 11.5 to 14.2 billion cubic feet between 1977 and 1997, then declining to 14.0 billion in 2007. Removals are projected to surpass growth around 2000.

THE FOURTH MINNESOTA FOREST INVENTORY: TIMBER VOLUMES AND PROJECTIONS OF TIMBER SUPPLY

John S. Spencer, Jr.
Principal Resource Analyst

TIMBER VOLUME INCREASED BETWEEN SURVEYS

The volume of growing stock on commercial forest land in Minnesota increased 21 percent between the previous inventory in 1962 (9.4 billion cubic feet) and the latest inventory in 1977 (11.5 billion). This increase occurred as the commercial forest land base declined 11 percent, from 15.4[1] to 13.7 million acres. The continuing recovery and maturation of the forest from the burned and denuded conditions prevalent in the early 1900's is the reason for the accumulating timber volumes.

Softwood growing-stock volume increased 3 percent between surveys, but hardwood volume jumped 32 percent:

Species group	Growing-stock volume 1962	1977
	(Million cubic feet)	
Softwoods	3,384	3,477
Hardwoods	6,060	7,977
Total	9,444	11,454

The volume of sawtimber on commercial forest land increased 65 percent between surveys—from 14.9 to 24.6 billion board feet[2]. Softwood volume increased 39 percent, but hardwood volume jumped 84 percent:

Species group	Sawtimber volume 1962	1977
	(Million board feet)	
Softwoods	6,133	8,530
Hardwoods	8,742	16,077
Total	14,875	24,607

Average volume per acre of growing stock increased from 613 to 836 cubic feet (7.8 to 10.6 cords) between surveys. Average sawtimber volume per acre increased from 965 to 1,797 board feet. The highest average growing-stock volume per acre is in the Northern Pine Unit—872 cubic feet.

In addition to the 11.5 billion cubic feet of growing stock in 1977, Minnesota has 1.2 billion of rough and rotten trees, 0.2 billion of short-log cull trees, and 0.1 billion of salvable dead trees (table 1). The total volume of timber in all classes is 13.0 billion cubic feet.

Table 1.—*Net volume of timber on commercial forest land by class of timber and softwoods and hardwoods, Minnesota, 1977*
(In million cubic feet)

Class of timber	All species	Softwoods	Hardwoods
Growing stock			
Sawtimber	4,732	1,719	3,013
Poletimber	6,722	1,758	4,964
Total growing stock	11,454	3,477	7,977
Rough and rotten cull	1,207	179	1,028
Short-log cull	185	27	158
Salvable dead	107	48	59
All classes	12,953	3,731	9,222

[1]*Published 1962 area and volume statistics have been adjusted to conform to 1977 statistics because of changes in procedures and definitions. (See Comparing Minnesota's Fourth Forest Survey with the Third Survey in Appendix.)*

[2]*International 1/4-inch rule.*

The Northern Pine Unit contains the largest volume of growing stock (5.0 billion cubic feet), followed by the Aspen-Birch Unit (4.5 billion), the Central Hardwoods Unit (1.5 billion), and the Prairie Unit (0.4 billion) (fig. 1). Ninety-eight percent of the softwood volume is in the Northern Pine and Aspen-Birch Units.

St. Louis County accounts for nearly one-fifth of the State's growing-stock volume (2.2 billion cubic feet). Itasca County contains the next largest volume (1.3 billion), followed by Koochiching (0.9 billion), Cass (0.9 billion), Lake (0.7 billion), and Beltrami Counties (0.7 billion) (fig. 2).

NONINDUSTRIAL PRIVATE OWNERS ACCOUNT FOR 39 PERCENT OF VOLUME

Farmers own 24 percent of the State's growing-stock volume, and other private nonindustrial parties own another 15 percent. Together, these two owner groups control the largest timber volume and area of commercial forest in Minnesota. Therefore, the nonindustrial private owner must play a significant role in future plans to improve and utilize the State's timber resource.

County and municipal agencies own 18 percent of the volume, followed by State (17 percent), National Forests (16 percent), forest industry (6 percent), and other federal agencies (4 percent) (fig. 3).

Nonindustrial private parties own 46 percent of the hardwood volume but only 22 percent of the softwood volume. The largest proportions of softwood volume are found on National Forest land (25 percent) and State land (24 percent) (table 2).

Aspen is the dominant species in the State in terms of growing-stock volume, with 3.4 billion cubic feet — 30 percent of the total. Its volume increased by 22 percent between surveys, although the area of aspen forest type declined by 97,500 acres. Much of the area loss resulted from creation of the Voyageurs National Park and expansion of the reserved portion of the Boundary Waters Canoe Area. Aspen was considered a low value weed species for years after it became widely established following intensive cutting of softwoods and subsequent slash burning and wildfires. But now it is regarded as a highly valuable resource by the paper and waferboard industries and as vital food and cover for ruffed grouse, deer, and other wildlife species.

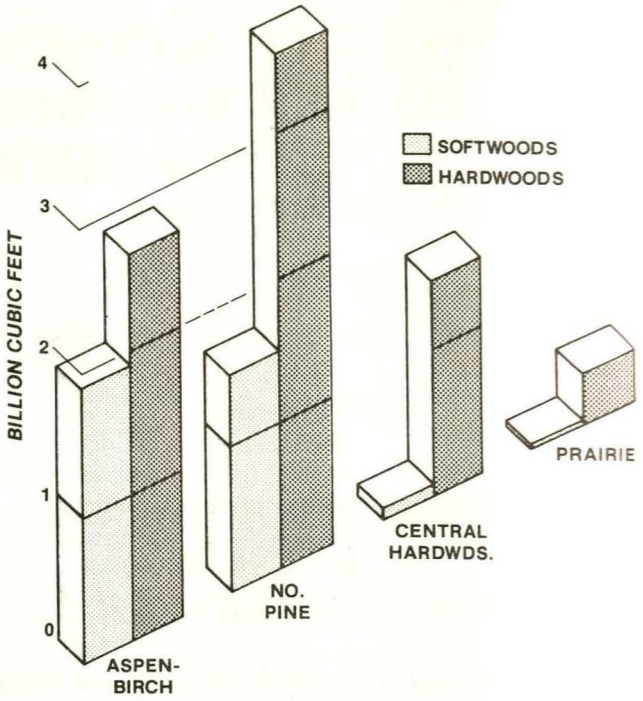

Figure 1.—*Net volume of growing stock on commercial forest land by softwoods and hardwoods and Forest Survey Unit, Minnesota, 1977.*

Paper birch, the species with the next largest volume, accounts for 1.3 billion cubic feet or 11 percent of the total. Aspen, paper birch, balsam fir (0.9 billion cubic feet), spruce (0.7 billion), and jack pine (0.6 billion) account for three-fifths of the State's growing-stock volume. Between surveys, paper birch and balsam fir volumes increased by 51 and 17 percent, respectively, but spruce and jack pine volumes declined 12 and 19 percent, respectively. Spruce and jack pine declined largely because of the transfer of commercial forest to productive-reserved status as the Voyageurs National Park was created and as the reserved portion of the Boundary Waters Canoe Area was enlarged.

EIGHTY PERCENT OF VOLUME IN TREES LESS THAN 12 INCHES IN DIAMETER

Four-fifths of the growing-stock volume is in trees 12 inches or less in diameter (fig. 4). The fact that 85 percent of the aspen volume is in those diameter classes contributes to this volume concentration. A much larger proportion of softwood volume is in the

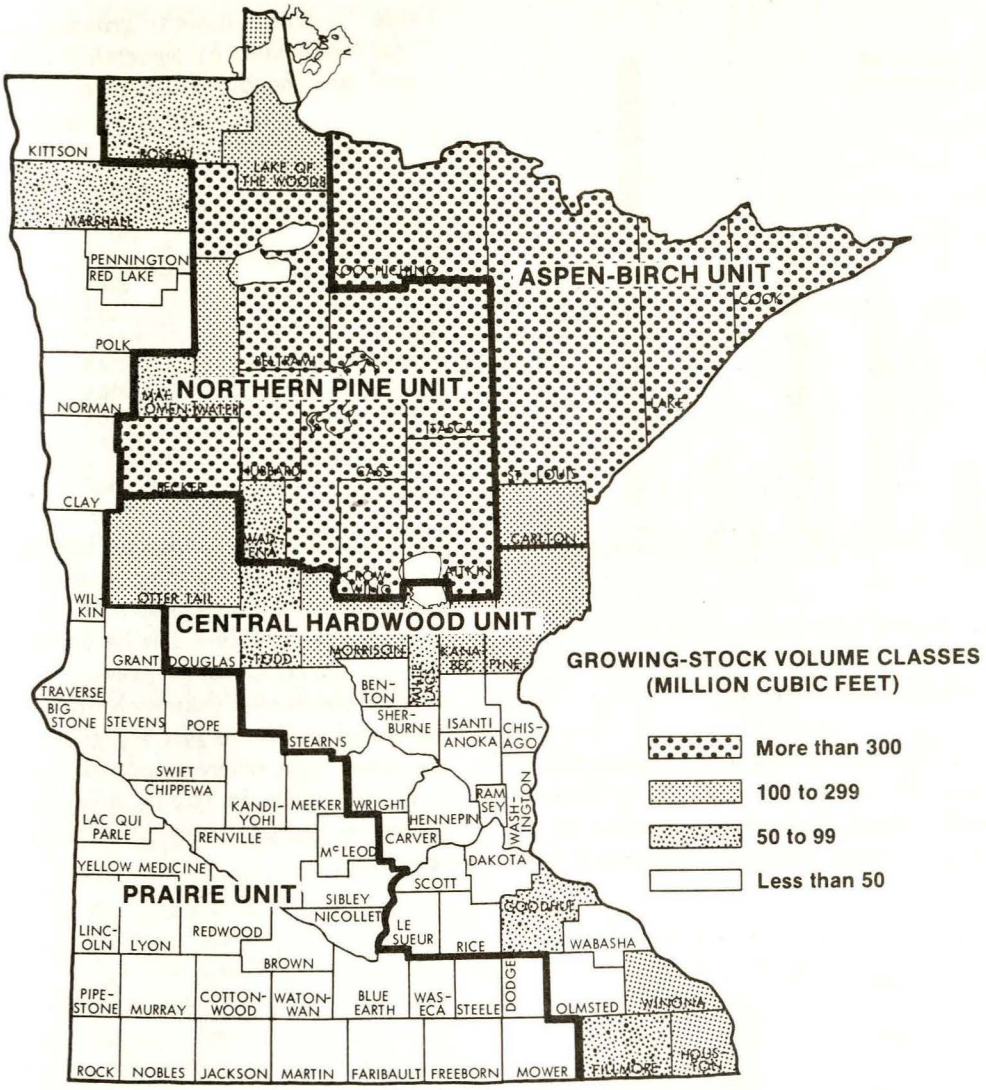

Figure 2.—*Growing-stock volume in Minnesota counties, 1977.*

smallest diameter classes than is true for hardwood volume — 51 percent of softwood growing-stock volume is in 6- and 8-inch trees, compared to 40 percent of the hardwood volume. This is true because of the large volumes in typically small-diameter softwoods — balsam fir, black spruce, and tamarack.

Thirty-one percent (1.1 billion cubic feet) of the softwood growing-stock volume is scattered throughout hardwood forest types, particularly the aspen type. For example, 36 percent of the total white spruce volume is in the aspen type and only 11 percent is in the white spruce type. And equal amounts (33 percent) of balsam fir volume are found in the aspen and balsam fir types. Conversely, only 6 percent of total hardwood volume is in softwood forest types.

Average volume per acre is highest in the white pine (1,587 cubic feet) and red pine (1,536) forest types, and lowest in the tamarack (438) and black spruce (474) types, compared to the State average of 836 cubic feet.

Seventy percent of the growing-stock volume is in stands aged 31 to 70 years (table 3). This surge in volume corresponds roughly to the swell of commercial forest area in stands aged 31 to 60, amounting to 49 percent of the total area. A much higher proportion of the volume in softwood forest types is in stands older than 90 years than is true of hardwood stands. The presence of long-lived species in the northern white-cedar, tamarack, and black spruce forest types accounts for much of the difference.

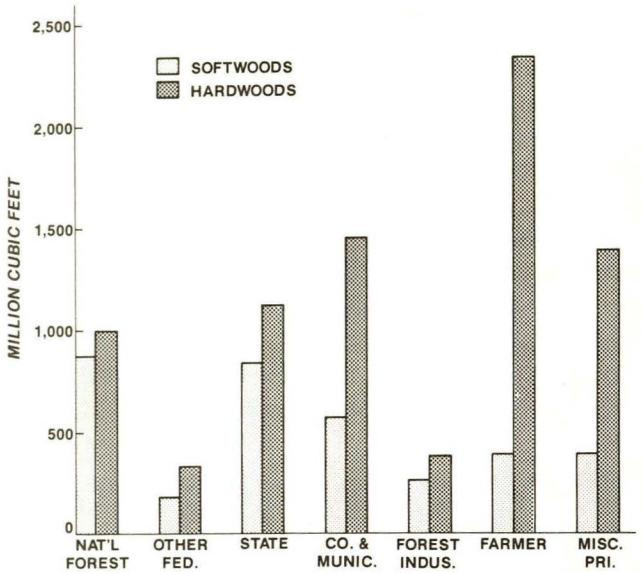

Figure 3.—*Net volume of growing stock on commercial forest land by softwoods and hardwoods and ownership class, Minnesota, 1977.*

The volume in the State's widespread aspen forest type reveals the same bulge in the 30- to 60-year classes (fig. 5). Recommended rotation age for aspen in the Lake States varies with site index and end

Table 2.—*Net volume of growing stock on commercial forest land by ownership class and softwoods and hardwoods, Minnesota, 1977*

(In million cubic feet)

Ownership class	All species	Softwoods	Hardwoods
National Forest	1,871.1	871.1	1,000.0
Bureau of Land Management	37.4	22.8	14.6
Indian	374.6	136.6	238.0
Misc. federal	96.6	20.2	76.4
State	1,942.1	818.2	1,123.9
County and municipal	2,012.3	566.7	1,445.6
Forest industry	636.0	265.0	371.0
Farmer	2,706.2	383.6	2,322.6
Miscellaneous private	1,777.7	392.8	1,384.9
Total	11,454.0	3,477.0	7,977.0

product. Generally, aspen on low sites (site index 50 and less) managed for fiber production is harvested at about age 35, and aspen on high sites (site index 70+) managed for sawtimber is harvested at about age 60 (Perala 1977). In many areas, low site index aspen deteriorates earlier than high site aspen and should be harvested earlier As seen in figure 5, a large volume in the aspen type, where 83 percent of the aspen volume is found, exists in stands more than 60 years old. Therefore, large losses of aspen are undoubtedly occurring.

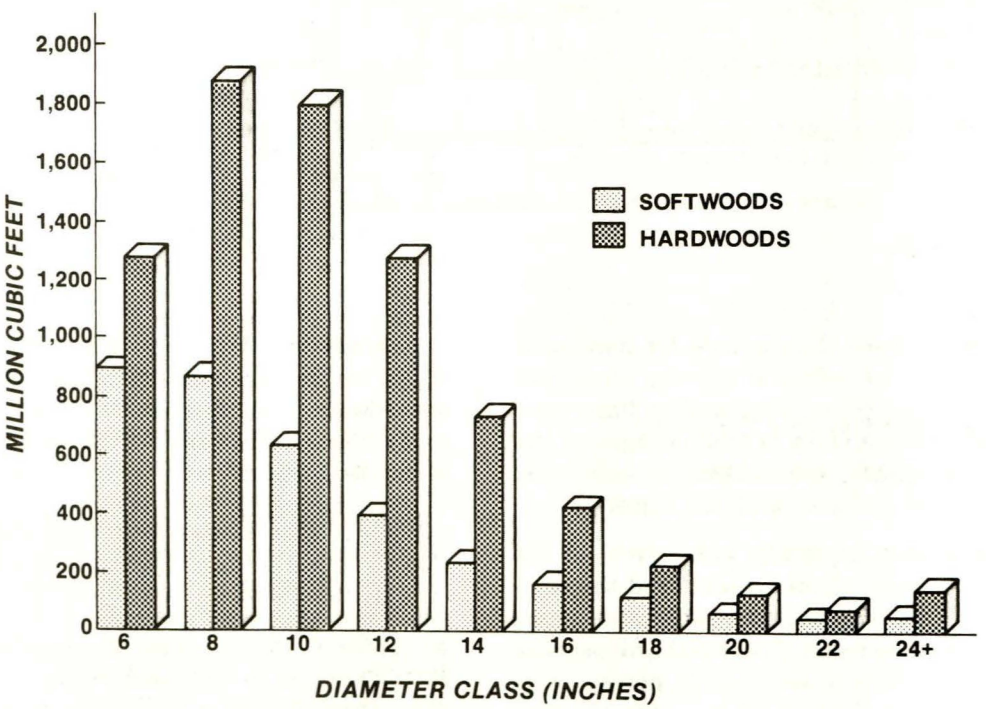

Figure 4.—*Net volume of growing stock on commercial forest land by softwoods and hardwoods and diameter class, Minnesota, 1977.*

Table 3.—*Net volume of growing stock on commercial forest land by stand-age class of softwood and hardwood forest types, Minnesota, 1977*

(In million cubic feet)

Stand-age class (years)	Forest type		
	Total	Softwood	Hardwood
0-10	241.9	27.4	214.5
11-20	280.2	62.1	218.1
21-30	431.0	113.3	317.7
31-40	1,413.5	285.2	1,128.3
41-50	2,729.8	505.8	2,224.0
51-60	2,502.8	561.8	1,941.0
61-70	1,415.2	339.1	1,076.1
71-80	921.5	326.0	595.5
81-90	568.7	185.4	383.3
91-100	501.6	217.0	284.6
101-120	259.2	107.6	151.6
121-140	185.5	115.0	70.5
141+	3.1	3.1	—
Total	11,454.0	2,848.8	8,605.2

QUALITY OF SAWTIMBER IS LOW

Three-fourths of the sawtimber in the State is in grade 3[3] logs (fig. 6), largely the result of the relatively small diameters of sawtimber trees. The proportion of volume in the higher grades (1 and 2) is much greater for hardwoods (22 percent) than for softwoods (9 percent). It is not possible to accurately compare sawtimber quality between surveys because different log grade standards were used on each occasion. However, average quality probably has not improved much since 1962 because of the relative youth of many stands.

Species with exceptionally high proportions of sawtimber volume in log grades 1 and 2 are basswood (47 percent), elm (41), yellow birch (32), ash (30), select red oaks (23), white pine (23), and soft maple (24).

GROWTH RATE IS 3 PERCENT

Net annual growth of growing stock declined from 364 to 349 million cubic feet from 1962 to 1976 — a 4-percent drop. Softwood growth increased by 12 percent between surveys (from 107 to 120 million cubic feet), but hardwood growth fell by 11 percent (from 257 to 229 million cubic feet).

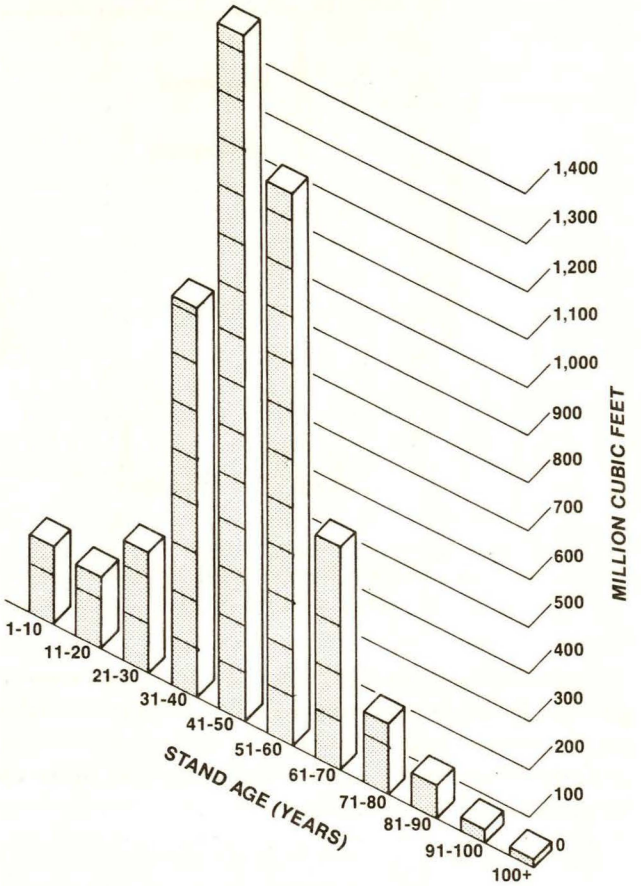

Figure 5.—*Net volume of growing stock in the aspen forest type on commercial forest land by stand-age class, Minnesota, 1977.*

The average net annual growth per acre remained nearly constant between surveys — 24 cubic feet in 1962 and 25 cubic feet in 1976.

The growth rate was 3.0 percent of inventory in 1976 and 3.9 percent in 1962. The 1976 softwood growth rate (3.4 percent) was higher than the hardwood rate (2.9 percent). Declining growth rates are to be expected in States like Minnesota where inventory volumes are expanding rapidly. For the growth rate to remain the same between surveys under such circumstances, the volume of growth would have to increase inordinately.

Practically all softwood growth volume is in the Northern Pine and Aspen-Birch Survey Units (fig. 7). Although the Northern Pine Unit accounts for the largest share of the hardwood growth, the hardwood growth rate is highest in the Central Hardwoods Unit (4.0 percent).

[3]*Third best of the four log grades used to estimate sawtimber quality in Minnesota, as described further in the Appendix.*

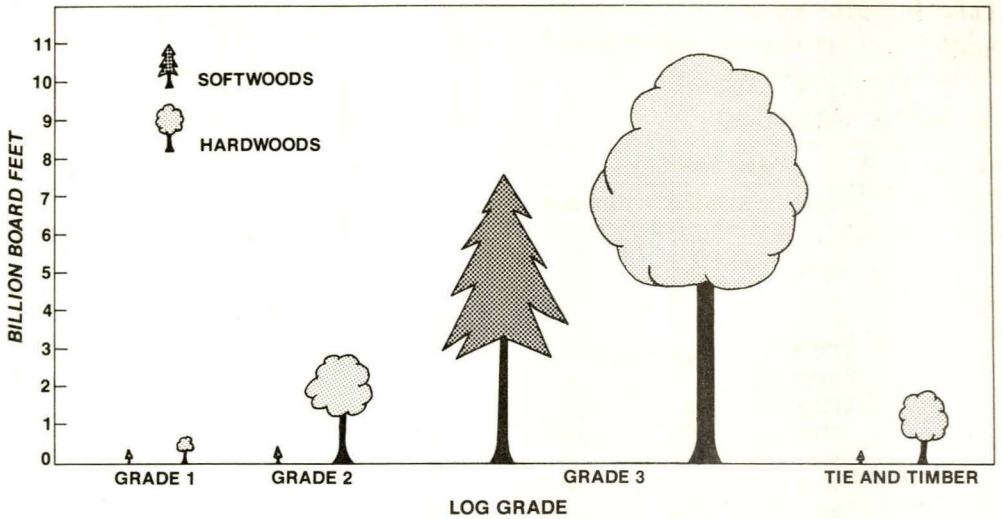

Figure 6.—*Net volume of sawtimber on commercial forest land by log grade and softwoods and hardwoods, Minnesota, 1977.*

Softwoods account for 34 percent of the volume of growth, although they represent only 30 percent of the growing-stock inventory. Hardwoods account for 66 percent of the growth volume, although they make up 70 percent of the inventory.

Growth rates on private land averaged 3.2 percent of inventory, somewhat higher than the average for public land (3.0 percent). The bulk of the softwood growth volume is on public land (fig. 8), just as most of the softwood inventory is on those lands.

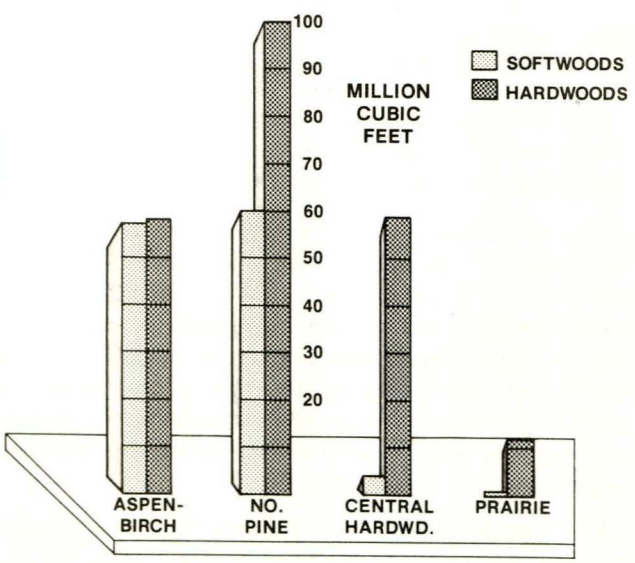

Figure 7. — *Net annual growth of growing stock on commercial forest land by softwoods and hardwoods and Forest Survey Unit, Minnesota, 1976.*

Net annual growth of sawtimber amounted to 1.1 billion board feet in 1976, 4.5 percent of inventory.

DISEASE IS LARGEST CAUSE OF MORTALITY

Mortality of growing-stock trees amounted to 142 million cubic feet in 1976, 1.2 percent of inventory. The mortality rate for softwoods (1.0 percent) is slightly lower than that for hardwoods (1.4 percent). The highest mortality rates are for tamarack (2.3 percent), aspen (2.1 percent), and balsam poplar (2.0 percent). Public owned forests boast the lowest mortality rates (1.1 percent), compared to privately owned forests (1.4 percent).

Disease caused 57 percent of the 1976 mortality volume, followed by weather (17 percent). All other causes accounted for the remaining 26 percent. Cause of mortality differed significantly by softwoods and hardwoods (fig 9.). Disease killed the largest volume of both softwoods and hardwoods, but it killed a much larger proportion of hardwoods (62 percent) than of softwoods (43 percent). Diseases of aspen, chiefly hypoxylon canker, account for 42 percent of the total hardwood mortality volume and for 32 percent of the total mortality of all species.

Annual mortality of sawtimber in 1976 was 263 million board feet, 1.1 percent of inventory.

TIMBER REMOVALS INCREASE — ESPECIALLY ASPEN

Timber removals from growing stock in 1976 amounted to 194 million cubic feet, an increase of one-third from 1962. Although removals for individual species varied between surveys, total softwood removals remained the same:

Species	Timber removals from growing stock	
	1962	1976
	(Million cubic feet)	
Softwoods	68.9	68.8
Hardwoods	77.0	124.8
All species	145.9	193.6

Aspen removals increased from 45.7 million cubic feet in 1962 to 73.0 million in 1976, a 60-percent gain. As these figures suggest, industrial interest in the aspen resource is heightening especially as waferboard plants under construction throughout the State begin operations. Jack pine removals were the second largest in the State in 1976 with 21.5 million cubic feet, although this was a decline of 5 percent from the 1962 level. Spruce (17.9 million cubic feet), balsam fir (13.9 million), red oak (10.1 million), and paper birch (9.1 million) were other species with large removals volumes.

Seventy percent of the total volume of removals was used for roundwood products (135.0 million cubic feet). Other removals — trees removed but not used for products, or trees left standing but "removed" from commercial forest classification by land use change — accounted for 28 percent of the total (53.5 million), and logging residues made up the remaining 2 percent (5.1 million).

A higher proportion of softwood removals are used for roundwood products (83 percent) than hardwood removals (63 percent).

Pulpwood is the most sought-after product in the State, representing 67 percent of the volume of roundwood products Saw logs account for 20 percent of the roundwood volume; fuelwood represents 7 percent — a figure that is expected to grow substantially in the future; and posts, poles, veneer logs, and other minor products account for the remaining 6 percent.

Forty percent of the total removals were from the Aspen-Birch Unit, which contained 39 percent of the inventory of growing stock. The Northern Pine Unit accounted for 38 percent of removals (44 percent of inventory), the Central Hardwood Unit made up 18 percent of removals (14 percent of inventory), and the Prairie Unit contributed 4 percent of removals (3 percent of inventory).

Private lands yielded 62 percent of the removals volume, but contained only 45 percent of the inventory. The 119 million cubic feet of removals from private land translate into a removals rate of 2.3 percent of inventory, compared to a rate on public land of 1.2 percent.

TIMBER REMOVALS ABOUT HALF OF GROWTH VOLUME

A comparison of 1976 timber removals with net annual growth shows that the volume of growth was almost double that of removals. However, a comparison of this kind may not be useful in States like Minnesota where stands are relatively young and growth includes a substantial volume from trees too small to be a significant part of the removals volume. A more meaningful comparison is one between removals and the yields from land managed under cutting prescriptions that represent the probable high and low range of future yields from the State. Predicted yields for all four Survey Units in Minnesota were computed and those for northern Minnesota were published (Jakes and Smith 1980). When used with other resource information, these predicted yields can identify deficiencies or surpluses in the forest resource. Yields were computed for 2 sets of prescriptions — a long rotation option based on rotation ages approximating current harvest practice, and a short rotation option that uses current empirical yields to select rotation age at the age of maximum total volume yield The long rotation option would produce both sawtimber and pulpwood; the short rotation option would produce primarily pulpwood.

A comparison of 1976 growth and removals with predicted yields from both the long and short rotation options for 1977-1986 shows that yields would be substantially greater than current removals, under certain assumptions (table 4). Average annual growing-stock removals for the decade under the long and short rotation options are 46 percent and 106 percent greater, respectively, than 1976 removals. The disparity is greater for hardwoods (54 percent and 125 percent) than for softwoods (30 percent and 73 percent). The difference between current removals and predicted yields is greatest in the Aspen-Birch Unit where average annual removals under the long rotation prescription would be nearly twice as large as 1976 removals.

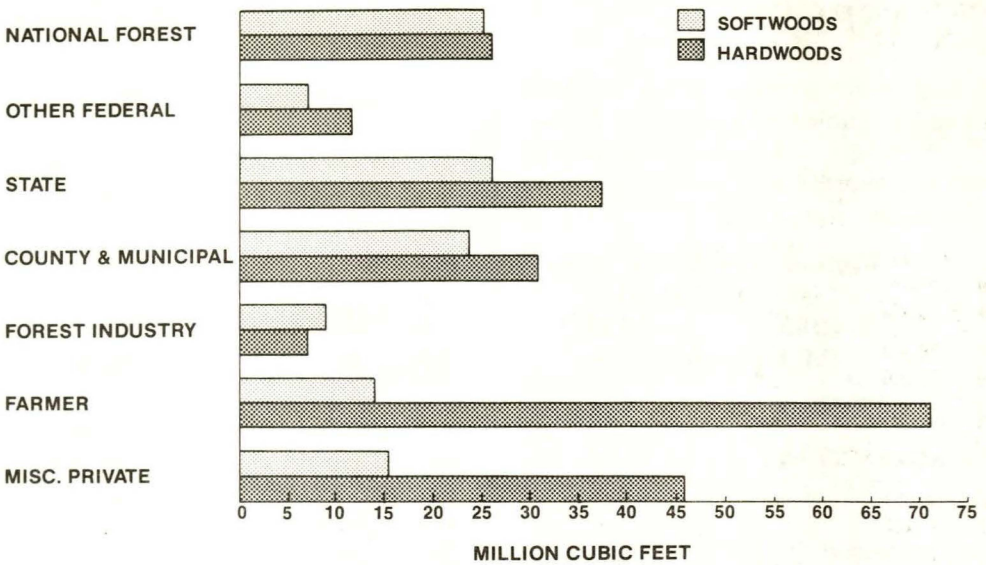

Figure 8. — *Net annual growth of growing stock on commercial forest land by softwoods and hardwoods and ownership class, Minnesota, 1976.*

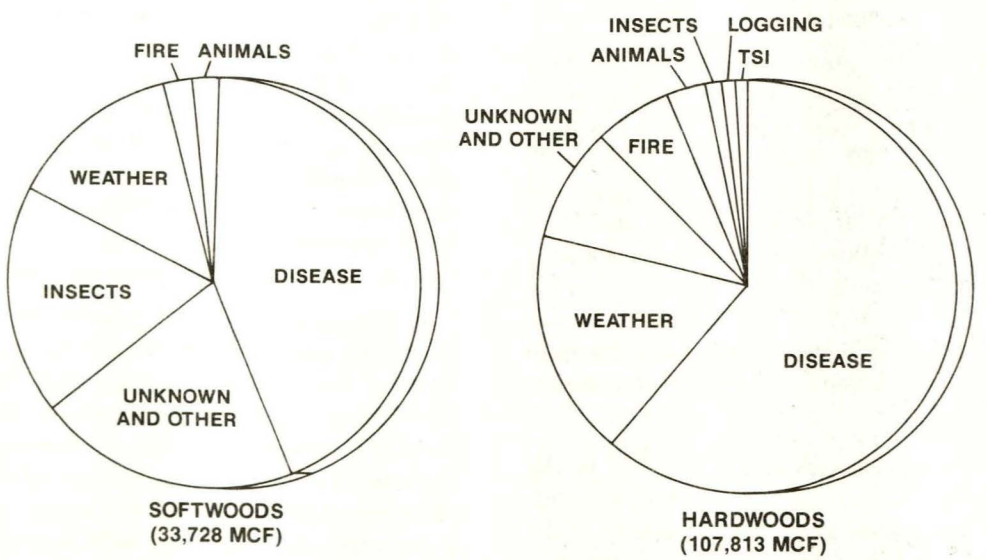

Figure 9. — *Annual mortality of growing stock on commercial forest land by softwoods and hardwoods and cause, Minnesota, 1976.*

Table 4.—*Net annual growth and removals of growing stock on commercial forest land for 1976 and average annual predicted yields from selected cutting prescriptions for 1977-1986 by softwoods and hardwoods, and Forest Survey Unit, Minnesota*

(In thousand cubic feet)

Species	Net annual growth	Annual timber removals	Predicted yields from selected cutting prescriptions: Long rotation age option	Predicted yields from selected cutting prescriptions: Short rotation age option
ALL UNITS				
Softwoods	119,781	68,800	89,378	118,915
Hardwoods	229,139	124,800	192,535	280,568
All species	348,920	193,600	281,913	399,483
ASPEN-BIRCH UNIT				
Softwoods	56,982	38,803	54,866	71,142
Hardwoods	57,917	38,445	93,608	117,588
All Species	114,899	77,248	148,474	188,730
NORTHERN PINE UNIT				
Softwoods	59,123	28,502	33,117	45,354
Hardwoods	100,669	44,926	72,303	103,273
All species	159,792	73,428	105,420	148,627
CENTRAL HARDWOODS UNIT				
Softwoods	3,562	1,339	1,269	2,246
Hardwoods	58,733	32,858	20,410	51,862
All species	62,295	34,197	21,679	54,108
PRAIRIE UNIT				
Softwoods	114	156	126	173
Hardwoods	11,820	8,571	6,214	7,845
All species	11,934	8,727	6,340	8,018

The predicted yields are based on the following assumptions: (1) all landowners are willing to sell their timber, (2) operability (the physical conditions that determine whether a stand can be harvested) and availability of timber stands are not obstacles to timber harvesting, and (3) markets exist for all commercial species. Because these assumptions represent ideal rather than existing conditions, the yields in table 4 should be discounted accordingly.

PROJECTIONS OF NATIONAL TIMBER SUPPLY

The most recent projection of national demand for roundwood shows consumption increasing from 13.3 billion cubic feet in 1976 to 25.2 billion in 2010, an 89-percent jump (USDA Forest Service 1980). Softwood demand is projected to grow from 10.3 to 17.7 billion cubic feet during the same period — a 72-percent gain, but hardwood demand is projected to jump from 3.0 to 7.5 billion cubic feet — a 150-percent increase. The faster rate of growth for hardwoods reflects a projected rise in demand for hardwood pulp products, hardwood lumber for pallets and railroad ties, and hardwood plywood and veneer for furniture. This projection, made at a medium level of population and economic growth, assumes that the price trends in the base period used in making the projection (roughly from the late 1950's through the mid 1970's) continue through the projection period.[4] When the excess of roundwood imports (4.5 billion cubic feet) over exports (1.5 billion) is subtracted from the projected demand in 2010, the result is the demand on United States forests — 22.2 billion cubic feet.

National supplies (timber available for harvest) of roundwood are projected to increase from 12.1 to 18.7 billion cubic feet between 1976 and 2010.[5] Softwood supplies are projected to increase from 9.2 to 11.6 billion cubic feet during the period, but hardwood supplies vault from 2.9 to 7.1 billion cubic feet. Projected demand on United States forests in 2010 exceeds supply by 3.5 billion cubic feet. The short-fall for softwoods (3.3 billion) is much larger than that for hardwoods (0.2 billion).

MINNESOTA'S TIMBER PROJECTIONS

Minnesota's timber resource will play a significant, though not major, role in the Nation's demand-supply outlook. A look at what is likely to happen to the State's future timber resource under several levels of removals can help put Minnesota in perspective with the Nation.

Two 30-year projections of the State's timber situation were made using the Timber Resource Analysis System (TRAS) program (USDA Forest Service 1970). One assumes a continuation of recent levels of timber removals (low removals option), and the other assumes a higher level of removals (high removals

[4] *Another projection was made under the assumption that prices will rise enough to maintain an equilibrium between projected demand and supply.*

[5] *Projection shows the volume of timber available for harvest from domestic forests if recent trends in the forces determining supply, such as commercial timberland area, management, and prices, continue through the projection period.*

option). Separate projections were made for softwoods and for hardwoods. TRAS uses a stand projection technique involving input of number of trees, growth rates, mortality rates, and removal rates, all by 2-inch diameter classes, along with assumed total removals by year and assumed ingrowth into the 2-inch diameter class.

Assumptions common to both options are: (1) the total area of commercial forest land will decline at an annual rate of 0.310 percent, from 13.7 million acres in 1977 to 12.4 million acres in 2007; (2) radial growth will decline in relation to the increase of basal area per acre of trees; (3) the intensity of forest management will continue at the rate indicated by recent trends; (4) the volume of "other" removals will drop during the period as more of these trees are utilized for products.

LOW REMOVALS OPTION PROJECTION

The low option assumes that softwood timber removals will increase at an average annual rate of 2.68 percent or 1.9 million cubic feet, and that hardwood removals will increase at an average annual rate of 2.73 percent or 3.5 million cubic feet. Growth is projected to exceed removals, to peak about 1987, and then to turn down. Therefore, inventory is projected to increase at an average annual rate of 1.11 percent or 128 million cubic feet, but to increase less rapidly during the last 15 years (fig. 10).

This projection shows removals increasing from 198 million cubic feet in 1977 to 360 million in 2007, an 81-percent gain. Softwood removals are projected to increase from 71 to 128 million cubic feet during the period, and hardwood removals are projected to expand from 128 to 232 million cubic feet. Removals for the major roundwood products — pulpwood, saw logs, and fuelwood — are all assumed to rise during the projection period but more of these products are assumed to be recovered from "other" removals. The construction of waferboard plants in the State is assumed to have a noticeable impact on hardwood removals.

Growth is projected to increase from 349 million cubic feet in 1977 to 432 million in 1987, then to decline to 375 million in 2007. At the beginning of the projection period, the surplus of growth over removals is 151 million cubic feet. By 1987 the surplus is projected to be 180 million cubic feet, but by 2007 it is projected to shrink to 16 million.

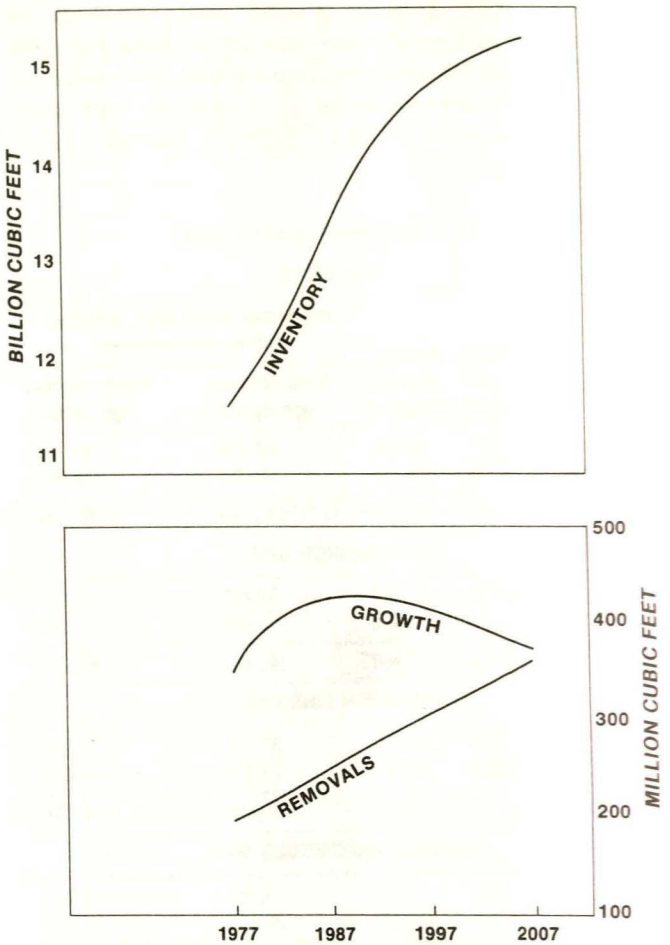

Figure 10.—*Removals, net growth, and inventory of growing stock in Minnesota, 1977, and low removals option projection for 1977-2007.*

The 1977 inventory of 11.5 billion cubic feet is projected to rise to 15.3 billion in 2007, a 33-percent gain. The rise of the inventory curve slows as the growth and removals curves converge, and the annual increase in inventory is projected to almost cease by 2000 when the growth and removals curves nearly cross.

HIGH REMOVALS OPTION PROJECTION

Timber removals under this option are assumed to increase at an annual rate of 4.45 percent or 3.2 million cubic feet for softwoods and to increase at an annual rate of 4.99 percent or 6.4 million cubic feet for hardwoods. Removals surpass growth about 2000 and widen their lead through 2007. Inventory is projected to increase more slowly as growth and removals converge and to turn down when the two curves bisect (fig. 11).

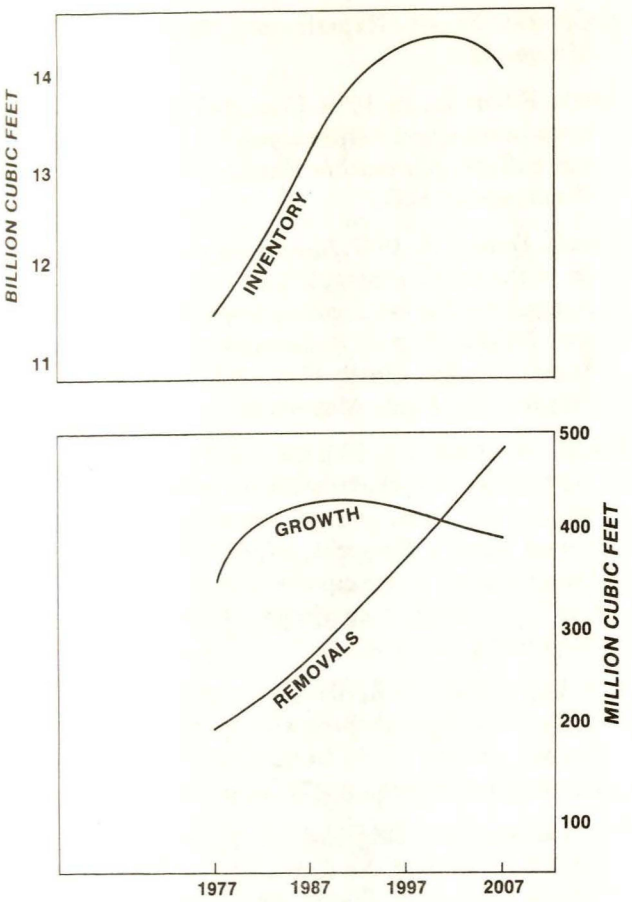

Figure 11.— *Removals, net growth, and inventory of growing stock in Minnesota, 1977, and high removals option projection for 1977-2007.*

Under the high removals option, removals jump from 199 to 486 million cubic feet between 1977 and 2007, a 144-percent gain. Softwoods are projected to increase from 71 to 166 million cubic feet and hardwoods from 128 to 320 million cubic feet. This option assumes more expanded markets for roundwood products than the low removals option does.

The 1977 growth of 349 million cubic feet is projected to rise to 432 million by 1987, then to sag to 393 million by 2007. The excess of growth over removals of 150 million cubic feet in 1977 is projected to enlarge to 162 million in 1987, then to do an about-face and end with a removals surplus of 93 million cubic feet in 2007.

Inventory rises from 11.5 to 14.2 billion cubic feet between 1977 and 1997. Then, in response to the widening imbalance of removals over growth and a shrinking commercial forest land base, it begins to decline about 2000 and reaches 14.0 billion cubic feet in 2007 — a net rise from 1977 of 22 percent.

THE OUTLOOK

The low and high removals options represent the forest situation only if the assumptions upon which they are based are realized. The projections are not intended to convey what is desirable from silvicultural, economic, or social viewpoints; they are simply indicators of what is likely to happen if forests are managed much as they have been for the last 15 years and if harvesting occurs at two different levels. Projections for the first decade are the most meaningful because fast-changing market and economic conditions can quickly nullify the assumptions under which projections for the last two decades were made.

Inventory, then, is likely to continue accumulating for the next decade at a rate similar to that of recent trends. After that, inventory will increase more slowly and, depending on such factors as rate of loss of commercial forest land and rate of timber removals, it will stabilize or decline. A more intensive level of timber management than that assumed could lead to increased timber growth and larger-than-projected inventories. Timber stand treatment opportunities in the State during 1977-1986 are discussed in "Projecting Treatment Opportunities for Current Minnesota Forest Conditions" (Smith and Jakes 1981). Timber supplies might also be extended through more complete utilization of residues, treetops, and limbs, the volumes of which are not included in timber inventories. Inventories would also be larger than projected if the actual area of commercial forest land converted to other uses is less than assumed or if much of the land converted is of low site quality.

What happens to the large area of aspen forest type in the State (39 percent of the commercial forest area) will have a major impact on Minnesota's future forest resource. If aspen stands are not disturbed, such as by logging or fire, they tend to be replaced by more shade-tolerant or longer-lived species. A coniferous understory was present in 27 percent of the aspen stands in 1977. By 2007 many of these stands could be converted by natural succession to softwood types such as balsam fir, spruce, and pine, unless the stands are logged or burned. The accelerating industrial interest in aspen, however, probably means that fewer aspen stands will remain undisturbed. Other aspen stands with tolerant hardwood understories will convert to the northern hardwoods type by natural succession also. The outlook, then, is for the area of the aspen type and its associated volumes to shrink somewhat in the future.

It seems likely that the volume of red and white pines, species traditionally preferred for lumber in the

State, will decline in the future. The areas of these forest types continue to diminish despite the amount of past red pine plantings.

Whatever happens to Minnesota's maturing forests will be largely determined by the attitudes of the State's nonindustrial private forest landowners who control 41 percent of the commercial forest land and 39 percent of the growing-stock volume. Policies that seek to bring practical, technical information and assistance on forest management to these owners will help to achieve a more favorable future timber outlook for the State. And policies that make timber-growing more profitable for these owners will have the same effect. Expanded markets for timber products and financial incentives, such as tax incentives for forest landowners and cost-share programs for tree planting and timber stand improvement, are some ways to make enlightened timber management more attractive to these owners.

LITERATURE CITED

Belcher, D.L., M. R. Holdaway, and G. J. Brand. (In prep.) STEMS: The stand and tree evaluation and modeling system. U.S. Department of Agriculture Forest Service, General Technical Report NC-79, p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Jakes, Pamela J., and W. Brad Smith. 1980. Predicted yields from selected cutting prescriptions in northern Minnesota. U.S. Department of Agriculture Forest Service, Research Paper NC-188, 29 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Little, Elbert L., Jr. 1979. Checklist of United States trees (native and naturalized). U.S. Department of Agriculture, Agriculture Handbook No. 541, 375 p. Washington, D.C.

Perala, Donald A. 1977. Manager's handbook for aspen in the north-central States. U.S. Department of Agriculture Forest Service, General Technical Report NC-36, 30 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

Smith, W. Brad, and Pamela J. Jakes. 1981. Projecting treatment opportunities for current Minnesota forest conditions. U.S. Department of Agriculture Forest Service, Research Paper NC-215, 21 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

U.S. Department of Agriculture, Forest Service. 1970. TRAS, a computer program for the projection of timber volume. U.S. Department of Agriculture, Agriculture Handbook 377, 24 p. Washington, D.C.

U.S. Department of Agriculture, Forest Service. 1980. An assessment of the forest and range land situation in the United States. FS-345, 631 p. Washington, D.C.

Vaughn, C. L., A. C. Wollin, K. A. McDonald and E. H. Bulgrin. 1966. Hardwood log grades for standard lumber. U.S. Department of Agriculture Forest Service, Research Paper FPL-63, 52 p. U.S. Department of Agriculture Forest Service, Forest Products Laboratory, Madison, Wisconsin.

APPENDIX

ACCURACY OF SURVEY

Resources Evaluation information is based on a sampling procedure designed to provide reliable statistics at the State and Survey Unit levels. Consequently, the reported figures are estimates only. Sampling errors give a measure of reliability of these figures. These sampling errors mean that the chances are two out of three that if a 100-percent inventory had been taken using the same methods, the results would have been within the limits indicated.

For example, the estimated growing-stock volume in Minnesota in 1977, 11,454.0 million cubic feet, has a sampling error of ± 1.04 percent (± 119,122 thousand cubic feet). The growing-stock volume from a 100-percent inventory, then, would be expected to fall between 11,573.1 and 11,334.9 million cubic feet (11,454.0 ± 119.1), there being a one in three chance that this is not the case.

Sampling errors were calculated separately for National Forest land because of the lower sampling intensity there. For example, the sampling error for growing-stock volume on land other than National Forest is ± .82 percent but for Chippewa National Forest land it is ± 7.47 percent.

The following tabulation shows the combined sampling errors for the 1977 Minnesota Forest Inventory:

Item	Minnesota totals	Sampling error (Percent)
Growing stock	(Million cubic feet)	
Volume	11,454.0	1.04
Growth	348.9	1.42
Removals	193.6	5.33
Sawtimber	(Million board feet)	
Volume	24,607.2	1.85
Growth	1,111.5	1.72
Removals	460.3	4.36
Commercial forest land	(Thousand acres) 13,695.1	0.39

As survey data are broken down into sections smaller than State or Survey Unit totals, the sampling error increases. The smaller the breakdown, the larger the sampling error. For example, the sampling error for growing-stock volume in a particular county is higher than that for growing-stock volume in the Survey Unit (table 51 shows the sampling errors for estimates smaller than State totals).

SURVEY PROCEDURE

The major steps in the Minnesota survey were as follows:

1. A total of 276,897 1-acre points were systematically distributed across aerial photos of the entire State, except the Chippewa and Superior National Forests. These points were classified as forest land (72,700), unproductive forest land (4,483), nonforest land (197,674), or questionable (2,040) to make a preliminary estimate of forest area. Next, all forest points (72,700), 592 of the unproductive forest points, and all questionable points (2,040) were stereoclassified as to forest type, stand-size class, and density. Then 9,796 points classed as forest, 592 points classed as unproductive, 276 points classed as questionable, and 25,498 points classified as nonforest were examined on the ground to correct the preliminary area estimate for errors in classification and for actual changes in land use since the photos were taken. At each of the 8,547 commercial forest locations, variable-radius plots (basal area factor 37.5) were established at 10 points uniformly placed over the sample acre. Tree measurements made at these locations were the basis for estimates of timber volume, growth, mortality, number of trees, and other forest classifications.

2. Growth and mortality on all commercial forest land were estimated[6] using the Stand and Tree Evaluation and Modeling System (STEMS). STEMS is an individual tree-growth projection system that uses the following stand and tree characteristics to grow trees by updating tree diameter and tree status (live, dead or cut): species, tree diameter, crown ratio, site index, basal area, and average stand diameter. These characteristics were used to produce growth and mortality rates that were adjusted based on ground conditions gained from remeasurement of plots and applied to trees on the tree list to yield an updated tree list. Local volume equations were applied to the original and updated tree lists to estimate volumes of growth and mortality.

[6] *STEMS was developed at the North Central Forest Experiment Station as part of the Forest Resources Evaluation Program (FREP). For more information on STEMS, see: Belcher et al. 1981.*

3. Data from the National Forests were incorporated into the Survey data. Area statistics for the Chippewa National Forest were prepared by the Chippewa's Timber Management staff from compartment examination records. In 1975, the Forest conducted its own inventory using the standard forest inventory system. Data from these plots were used as input for STEMS, which was modified and used to update volumes to 1977. The updated Chippewa National Forest data were approved by the Forest and combined with Survey data from non-National Forest commerical forest land to estimate volume, growth, and mortality for the State.

Area statistics for the Superior National Forest were prepared by the Superior's Timber Management staff from compartment examination records. Volume data for Superior National Forest land were prepared from permanent sample plots established by Forest personnel. Superior National Forest data, were then added to data for the rest of the State computed from 10-point variable radius plots.

4. Statistics on timber utilization during 1975 were obtained from mill surveys. The Minnesota Department of Natural Resources and the North Central Forest Experiment Station canvassed State sawmills, neer mills, and other primary wood-using plants. e North Central Station canvassed State pulpmills, well as out-of-State sawmills, pulpmills, and veneer ills to determine their use of timber from Minnesoa. Fuelwood and fencepost output was based on a sample of private landowners and on a canvass of industrial and public timber owners. Estimates of primary mill residue used for fuelwood were obtained from the canvass of Minnesota primary wood-using plants. Timber cut for products was determined for each ownership class by a canvass of public and industrial timber owners. The portion of timber cut unaccounted for by the latter owners was grouped under "farmer and other owners."

5. A total of 1,028 felled trees on 80 active logging operations were measured throughout the State during 1975-1976 to develop wood utilization factors for converting timber products output to timber removals for saw logs and pulpwood. Factors for veneer logs were obtained during the 1967-1968 Wisconsin utilization study. Factors for all other products were obtained during the 1960-1961 Minnesota utilization study.

6. Field data were sent to St. Paul and compiled.

COMPARING MINNESOTA'S FOURTH SURVEY WITH THE THIRD SURVEY

Data from new forest surveys are often compared with data from earlier ones to determine trends in forest areas and volumes. Changes in procedures and definitions between surveys make it necessary to adjust earlier data to make them comparable.

Because the Unit boundaries in Minnesota changed between surveys, the 1962 commercial forest area data were adjusted to take these changes into account. Then, a portion of the 1962 commercial forest area was withdrawn and added to unproductive forest (noncommercial) and to nonforest to allow for changes in the method of determining land uses. The resulting adjusted 1962 commercial area was then used to adjust 1962 inventory, net growth, and mortality volumes.

A test was made to ensure that it was possible to move from the adjusted 1962 volumes to the new 1977 volumes by means of Timber Resource Analysis System (TRAS), a Forest Service computer program for updating, backdating, and projecting timber volume, growth, mortality, and removals. For the program to work, the 2 years to be reconciled must have comparable commercial forest land bases so that changes in volumes between surveys reflect actual changes in forest conditions or land use. Therefore, it was necessary to adjust the 1962 data further so that land transferred from commercial forest to productive-reserved between the two surveys would not appear in the 1962 land base. If this adjustment were not made, removals between 1962 and 1977 would appear artificially high to absorb the loss of timber from this change in land status. This adjustment was made for the test only; area and volumes removed for the test were added back into the 1962 reported data.

TRAS recalculated 1962 volumes using 1977 estimates of cubic foot volume per tree and 1977 board foot-cubic foot ratios. This volume adjustment was necessary so that volume differences between surveys represented actual change and not merely change in the volume equations used on each occasion.

The adjusted 1962 volumes and area were distributed among the four Survey Units. A check was made to ensure that it was possible to move from the adjusted 1962 volumes to the new 1977 volumes in each Unit.

This was done using the average periodic difference between growth and removals for the two surveys and applying this difference to the 1962 volume. The same procedure was repeated for each individual species within each Unit to make sure inventory volumes reported for each species were consistent with reported growth and removals volumes.

Removals estimates for 1962 and 1977 are for total removals, including timber cut in addition to "other" removals, and are trend level removals. "Other" removals from transfer of commercial forest land to productive-reserved are not included. Previously published 1960 estimates are of timber cut only and do not include "other" removals. TRAS generated an estimate of 1962 "other" removals to provide the adjusted 1962 total removals.

LOG GRADE

In Minnesota the butt log of every sawtimber tree on every full permanent sample plot (12,994 trees) was graded for quality. Also graded were all logs in a smaller sample of trees throughout the State (1,028 trees). The volume yield by log grade for each tree in this smaller sample was used to distribute the volume of trees in the larger sample into log-grade classes. The resulting volumes by log-grade classes were expanded to provide an estimate for the entire State.

Logs were graded on the basis of external characteristics. Hardwood species were graded according to "Hardwood Log Grades for Standard Lumber" (Vaughn *et al.* 1966). The best 12-foot section of the lowest 16-foot hardwood log, or the best 12-foot upper section if the butt log did not meet minimum log-grade standards, was graded as follows:

Forest Service standard grades for hardwood factory saw logs

Grading Factors		Specifications							
		Log grade 1			Log grade 2				Log grade 3
Position in tree		Butts only	Butts and uppers		Butts and uppers				Butts and uppers
Scaling diameter, inches		[1]13-15	16-19	20+	[2]11+		12+		8+
Length without trim, feet			10+		10+	8-9	10-11	12+	8+
Required clear cuttings[3] of each of three best faces[4]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than one-fourth of end in sound defects		15 percent				30 percent		50 percent
	For logs with more than one-fourth of end in sound defects		10 percent				20 percent		35 percent
Maximum scaling deduction			40 percent[5]				50 percent[6]		50 percent

[1]Ash and basswood butts can be 12 inches if they otherwise meet requirements for small #1's.
[2]Ten-inch logs of all species can be #2's if they otherwise meet requirements for small #1's.
[3]A clear cutting is a portion of a face, extending the width of the face, that is free of defects.
[4]A face is one-fourth of the surface of the log as divided lengthwise.
[5]Otherwise #1 logs with 41-60 percent deductions can be #2.
[6]Otherwise #2 logs with 51-60 percent deductions can be #3.

Forest Service standard specifications for hardwood construction logs (tie and timber logs)[1]

Position in tree		Butt and upper
Min. diameter, small end		8 inches+
Min. length, without trim		8 feet
Clear cuttings		No requirements
Sweep allowance, absolute		One-fourth of the diameter of the small end for each 8 feet of length.
Sound surface defects	Single knots	Any number, if no one knot has an average diameter above the callus in excess of one-third of log diameter at point of occurrence.
	Whorled knots	Any number if sum of knot diameters above the callus does not exceed one-third of log diameter at point of occurrence.
	Holes	Any number, provided none has a diameter over one-third of log diameter at point of occurrence, and none extends over 3 inches into included timber.[2]
Unsound surface defects		Same requirements as for sound defects if they extend into included timber.[2] No limit if they do not.
End defects	Sound	No requirements.
	Unsound	None allowed; log must be sound internally, but will admit one shake not to exceed one-fourth of the scaling diameter and will admit a longitudinal split not extending more than 5 inches into the contained timber.

[1]These specifications are minimum for the class. If, from a group of logs, factory logs are selected first, thus leaving only nonfactory logs from which to select construction logs, then the quality range of the construction logs selected is limited, and the class may be considered a grade. If selection for construction logs is given first priority, then it may be necessary to subdivide the class into grades.

[2]Included timber is always square, and dimension is judged from small end.

Softwood species were graded according to the specifications on the following page.

Log Grades for Eastern White Pine

Log grade	Minimum size Diameter	Minimum size Length[1]	Sweep or crook allowance	Total cull allowance including sweep	Maximum weevil injury	Allowable knot size (inches)[2] on three best faces or minimum clearness on four faces
	(inches)	*(feet)*	*----(percent)----*		*(number)*	*(inches)*
1	12 & 13	8-16	20	50	0	Four faces clear full length
	14+	10-16	20	50	0	Two faces clear full length, or four faces clear 50% length (6 feet min. length) or[3]
2	6+	8-16	30	50	0	Sound knots 1.e[4] D/6 and less than 3 inches.[5] Unsound knots: 1.e 1-1/2 inches and for: butt, lots 1.e. D/12, upper logs 1.e. D/10, or four faces clear 50 percent of length
3	6+	8-16	40	50	8 foot logs: 1 weevil 10 foot+ logs: 2 weevils	Sound knots 1.e. D/3 and less than 5 inches. Unsound knots 1.e. D/6 and less than 2-1/2 inches.
4	6+	8-16	50	50	No limit	No limit

[1]Plus trim.
[2]Disregard all knots less than 1/2-inch diameter in all grades.
[3]The sum of the diameter of sound knots plus twice the sum of the diameter of unsound knots (in inches) is less than or equal to half of the diameter of the log (inches).
[4]1.e. means less than or equal to.
[5]D means d.i.b. of log at knot.

Log Grades for Jack Pine and Red Pine

Grade 1: logs with three or four clear faces.[7]

Grade 2: logs with one or two clear faces.

Grade 3: logs with no clear faces.

After the tentative log grade is established, the log will be degraded one grade for sweep or heart rot. No log can be degraded below grade 3. Net scale after deduction for defect must be at least 50 percent of the gross contents of the log.

1. *Sweep.* Degrade any tentative 1 or 2 log one grade if sweep amounts to 3 or more inches and equals or exceeds one-third the diameter inside bark at small end.

2. *Heart rot.* Degrade any tentative 1 or 2 log one grade if conk, massed hyphae, or other evidence of advanced heart rot is found.

[7]*A face is one-fourth of the circumference in width extending full length of the log. Clear faces are those free of knots measuring more than 1/2-inch in diameter, overgrown knots of any size, or holes more than 1/4-inch in diameter. Faces may be rotated to obtain the maximum number of clear ones.*

Log Grades for All Other Softwood Logs

Grade 1

1. Logs must be 16 inches or larger, 10 feet or longer,

and with deduction for defect not over 30 percent of gross scale.
2. Logs must be at least 75 percent clear on each of three faces.
3. All knots outside clear cutting must be sound and not more than 2-1/2 inches in diameter.

Grade 2

1. Logs must be 12 inches or larger, 10 feet or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.
2. Logs must be at least 50 percent clear on each of three faces or 75 percent clear on two faces.

Grade 3

1. Logs must be 6 inches or larger, 8 feet or longer, and with a net scale after deduction for defect of at least 50 percent of the gross contents of the log.

Note: (A) Diameters are d.i.b. at small end of log.

(B) Percent clear refers to percent clear in one continuous section.

PRINCIPAL TREE SPECIES GROUPS IN MINNESOTA (Little 1979)

SOFTWOODS	
Eastern white pine	*Pinus strobus*
Red pine	*Pinus resinosa*
Jack pine	*Pinus banksiana*
Black spruce	*Picea mariana*
White spruce	*Picea glauca*
Balsam fir	*Abies balsamea*
Tamarack	*Larix laricina*
Northern white-cedar	*Thuja occidentalis*
Other softwoods:	
Eastern redcedar	*Juniperus virginiana*
Scotch pine	*Pinus sylvestris*
HARDWOODS	
White oaks:	
White oak	*Quercus alba*
Bur oak	*Quercus macrocarpa*
Swamp white oak	*Quercus bicolor*
Select red oak:	
Northern red oak	*Quercus rubra*
Other red oaks:	
Black oak	*Quercus velutina*
Northern pin oak	*Quercus ellipsoidalis*
Hickories:	
Shagbark hickory	*Carya ovata*
Bitternut hickory	*Carya cordiformis*
Yellow birch	*Betula alleghaniensis*
Hard maples:	
Sugar maple	*Acer saccharum*
Black maple	*Acer nigrum*
Soft maples:	
Red maple	*Acer rubrum*
Silver maple	*Acer saccharinum*
Ashes:	
White ash	*Fraxinus americana*
Black ash	*Fraxinus nigra*
Green ash	*Fraxinus pennsylvanica*
Balsam poplar	*Populus balsamifera*
Paper birch	*Betula papyrifera*
Aspens:	
Bigtooth aspen	*Populus grandidentata*
Quaking aspen	*Populus tremuloides*
Basswood	*Tilia americana*
Elms:	
American elm	*Ulmus americana*
Slippery elm	*Ulmus rubra*
Rock elm	*Ulmus thomasii*
Select hardwoods:	
Butternut	*Juglans cinerea*
Black walnut	*Juglans nigra*
Black cherry	*Prunus serotina*
Other hardwoods:	
Boxelder	*Acer negundo*
River birch	*Betula nigra*
Hackberry	*Celtis occidentalis*
Eastern cottonwood	*Populus deltoides*
Black willow	*Salix nigra*
Kentucky coffeetree	*Gymnocladus dioicus*

METRIC EQUIVALENTS OF UNITS USED IN THIS REPORT

1 acre = 4,046.86 square meters or 0.405 hectare.
1,000 acres = 405 hectares.
1,000 board feet (International 1/4-inch log rule) = 3.48 cubic meters.
Breast height = 1.4 meters above the ground.
1 cubic foot = 0.0283 cubic meter.
1 foot = 30.48 centimeters or 0.3048 meter.
1 inch = 25.4 millimeters, 2.54 centimeters, or 0.0254 meter.

DEFINITION OF TERMS

Land-use Classes

Gross area. — The entire area of land and water as determined by the Bureau of Census, 1970.

Land area. — The area of dry land and land temporarily or partially covered by water such as marshes, swamps, flood plains, streams, sloughs, and estuaries. Canals less than 1/8-mile wide, and lakes, reservoirs, and ponds smaller than 40 acres are included as land area. These figures are from the Bureau of Census, 1970.

Forest land. — Land at least 16.7 percent stocked by forest trees of any size, or formerly having such tree cover, and not currently developed for nonforest use. Includes afforested areas. The minimum forest area classified was 1 acre. Roadside, streamside, and shelterbelt strips of timber must have a crown width of at least 120 feet to qualify as forest land. Unimproved roads and trails, streams, and clearings in forest areas were classed as forest if less than 120 feet wide.

Commercial forest land. — Forest land that is producing or is capable of producing crops of industrial wood and that is not withdrawn from timber utilization by statute or administrative regulation. This includes areas capable of producing in excess of 20 cubic feet per acre of annual growth. This includes both inaccessible and inoperable areas.

Noncommercial forest land. — (a) **Unproductive** — forest land incapable of yielding crops of industrial wood because of adverse site conditions, (b) **Productive-reserved** — forest land withdrawn from commercial timber use through statute or administrative regulation, or exclusively used for Christmas tree production.

Nonforest land. — Land that has never supported forests, and land formerly forested where use is precluded by development for nonforest uses, such as cropland, improved pasture, residential areas, and city parks. Also includes improved roads and adjoining rights-of-way, powerline clearings, and certain areas of water classified by the Bureau of Census as land. Unimproved roads, streams, canals, and nonforest strips in forest areas must be more than 120 feet wide, and clearings in forested areas must be more than 1 acre in size, to qualify as nonforest land.

Ownership Classes

National forest. — Federal land that has been designated by executive order or statute as National Forests or purchase units and other land under the administration of the USDA Forest service.

Other Federal. — Federal land other than National Forest.

State, county, and municipal. — Land owned by States, counties, or local public agencies, or land leased by them for more than 50 years.

Indian. — Tribal lands held in fee but administered by the federal government.

Forest industry. — Land owned by companies or individuals operating primary wood-using plants.

Farmer-owned. — Land owned by operators of farms. A farm must include 10 or more acres from which the sale of agricultural products totals $50 or more annually, or if less than 10 acres, the yield must be at least $250 annually.

Farmer-owned, leased. — Land owned by operators of farms but leased to other parties.

Miscellaneous private-corporation. — Land owned by a private corporation not in the business of operating primary wood-using plants.

Miscellaneous private-individual. — Land owned by a private individual.

Miscellaneous private-corporation, leased. — Land owned by private corporations but leased to other parties.

Miscellaneous private-individual, leased. — Land owned by private individuals but leased to other parties.

Tree Classes

All live trees. — Growing-stock, rough, and rotten trees 1 inch d.b.h. and larger.

Growing-stock trees. — All live trees of commercial species except rough and rotten trees.

Desirable trees. — Growing-stock trees having no serious quality defects that would limit present or prospective use, possessing relatively high vigor, and containing no pathogens that may kill or seriously damage them before rotation age. These are trees that would be favored by forest managers in silvicultural operations.

Acceptable trees. — Trees meeting the standards for growing stock but not qualifying as desirable trees.

Sawtimber trees. — Growing-stock trees of commercial species containing at least a 12-foot saw log or two noncontiguous saw logs, each 8 feet or longer. At least 33 percent of the gross volume of the tree must be sound wood. Softwoods must be at least 9 inches d.b.h. and hardwoods at least 11 inches d.b.h.

Poletimber trees. — Growing-stock trees of commercial species at least 5 inches d.b.h. but smaller than sawtimber size and of good form and vigor.

Saplings. — Live trees of commercial species 1 to 5 inches d.b.h. and of good form and vigor.

Seedlings. — Live trees of commercial species less than 1 inch d.b.h. that are expected to survive according to regional standards (examples of seedlings not expected to survive are those that are diseased or heavily damaged by logging, browsing, or fire). Only softwood seedlings more than 6 inches tall and hardwood seedlings over 1 foot in height are counted.

Rotten trees. — Live trees (any size) of commercial species that do not contain a merchantable 12-foot saw log or two noncontiguous 8-foot or longer saw logs, now or prospectively, because of rot (that is, when more than 50 percent of the cull volume of the tree is rotten).

Rough trees. — Live trees that do not contain at least one merchantable 12-foot saw log or two noncontiguous 8-foot or longer saw logs, now or prospectively, because of roughness and poor form. Includes all live noncommercial species.

Short-log (rough trees). — Sawtimber-sized trees of commercial species that contain at least one merchantable 8- to 11-foot saw log but not a 12-foot saw log.

Stocking

The degree of utilization of land by trees as measured in terms of basal area and/or the number of trees in a stand compared to the basal area and/or number of trees required to utilize fully the growth potential of the land.

A stocking percent of 100 indicates full utilization of the site and is equivalent to 80 square feet of basal area per acre in trees 5 inches d.b.h. and larger. In a stand of trees less than 5 inches d.b.h., a stocking percent of 100 would indicate that the present number of trees is sufficient to produce 80 square feet of basal area per acre when the trees reach 5 inches d.b.h.

Stocking of all live trees, growing-stock trees, and desirable trees are recorded separately and stands are grouped into the following stocking classes.

Stocking Classes

Overstocked stands. — Stands in which stocking of trees is 133 percent or more.

Fully-stocked stands. — Stands in which stocking of trees is from 100 to 133 percent.

Medium-stocked stands. — Stands in which stocking of trees is from 60 to 100 percent.

Poorly-stocked stands. — Stands in which stocking of trees is from 16.7 to 60 percent.

Nonstocked areas. — Commercial forest land on which stocking of trees is less than 16.7 percent.

Stand-size Classes

Stand. — A growth of trees on a minimum of 1 acre of forest land that is stocked by forest trees of any size.

Sawtimber stands. — Stands at least 16.7 percent stocked with growing-stock trees, at least half of which are sawtimber or poletimber trees, and sawtimber stocking at least equal to that of poletimber.

Poletimber stands. — Stands at least 16.7 percent stocked with growing-stock trees, at least half of which are sawtimber and/or poletimber trees, and poletimber stocking exceeding that of sawtimber.

Sapling-seedling stands. — Stands at least 16.7 percent stocked with growing-stock trees and with saplings and/or seedlings comprising more than half of this stocking.

Nonstocked areas. — Commercial forest land on which stocking of growing-stock trees is less than 16.7 percent.

Other Classifications

Site index. — An expression of forest site quality based on the height of a free-growing dominant or codominant tree of a representative species in the forest type at age 50.

Site class. — A classification of forest land in terms of inherent capacity to grow crops of industrial wood expressed in cubic-foot growth per acre per year.

Stand-age. — Age of the main stand. Main stand refers to trees of the dominant forest type and stand-size class.

Basal area. — The area in square feet of the cross section at breast height of a single tree. When the basal area of all the trees in a stand are summed, the result is usually expressed as square feet of basal area per acre.

Forest Types

A classification of forest land based on the species forming a plurality of live-tree stocking. Major forest types in Minnesota are:

Jack pine. — Forests in which jack pine comprises a plurality of the stocking. (Common associates include eastern white pine, red pine, aspen, birch, and maple.)

Red pine. — Forests in which red pine comprises a plurality of the stocking. (Common associates include eastern white pine, jack pine, aspen, birch, and maple.)

White pine. — Forests in which eastern white pine comprises a plurality of the stocking. (Common associates include red pine, jack pine, aspen, birch, and maple.)

Balsam fir. — Forests in which balsam fir and white spruce comprise a plurality of the stocking with balsam fir the most common. (Common associates include white spruce, aspen, maple, birch, northern white-cedar, and tamarack.)

White spruce. — Forests in which white spruce and balsam fir comprise a plurality of the stocking with white spruce the most common. (Common associates include balsam fir, aspen, maple, birch, northern white-cedar, and tamarack.)

Black spruce. — Forests in which swamp conifers comprise a plurality of the stocking with black spruce the most common. (Common associates include tamarack and northern white-cedar.)

Northern white-cedar. — Forests in which swamp conifers comprise a plurality of the stocking with northern white-cedar the most common. (Common associates include tamarack and black spruce.)

Tamarack. — Forests in which swamp conifers comprise a plurality of the stocking with tamarack the most common. (Common associates include black spruce and northern white-cedar.)

Oak. — Forests in which northern red oak, white oak, or bur oak, singly or in combination, comprise a plurality of the stocking. (Common associates include elm, maple, and aspen.)

Elm-ash-cottonwood. — Forests in which lowland elm, ash, cottonwood, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include basswood, and balsam poplar.)

Maple-basswood. — Forests in which sugar maple, basswood, yellow birch, upland American elm, and red maple, singly or in combination, comprise a plurality of the stocking. (Common associates include white pine, and elm.)

Aspen. — Forests in which quaking aspen or bigtooth aspen, singly or in combination, comprise a plurality of the stocking. (Common associates include balsam poplar, balsam fir, and paper birch.)

Paper birch. — Forests in which paper birch comprises a plurality of the stocking. (Common associates include maple, aspen, and balsam fir.)

Balsam poplar. — Forests in which balsam poplar comprises a plurality of the stocking. (Common associates include aspen, elm, and ash.)

Timber Volume

Volume of growing stock. — Net volume in cubic feet of growing-stock trees 5.0 inches d.b.h. and over, from a 1-foot stump to a minimum 4.0-inch top diameter outside bark of the central stem or to the point where the central stem breaks into limbs. Cubic feet can be converted to cords by multiplying by 79 cubic feet per solid wood cord.

Volume of sawtimber. — Net volume of the saw log portion of live sawtimber trees in board feet (International 1/4-inch rule) from stump to a minimum 7 inches top diameter outside bark (d.o.b.) for softwoods and a minimum 9 inches top d.o.b. for hardwoods.

Upper stem portion. — That part of the bole of sawtimber trees above the merchantable sawtimber top to a minimum top diameter of 4 inches outside bark or to the point where the central stem breaks into limbs.

Growth and Mortality

Net annual growth of growing stock. — The annual change in volume of sound wood in live growing-stock and sawtimber trees and the total volume of trees entering these classes through ingrowth, less volume losses resulting from natural causes.

Net annual growth of sawtimber. — The annual change in volume of live sawtimber trees and the total volume of trees reaching sawtimber size, less volume losses resulting from natural causes.

Mortality of growing stock. — The volume of sound wood in growing-stock trees that died during the year.

Mortality of sawtimber. — The net board-foot volume of sawtimber trees that died during the year.

Timber Removals

Timber removals from growing stock. — The volume of sound wood in growing-stock trees removed annually for forest products (including roundwood products and logging residues) and for other removals. Roundwood products are logs, bolts, or other round sections cut and used from trees. Logging residues are the unused portions of cut trees plus unused trees killed by logging. Other removals are growing-stock trees removed but not utilized for products or trees left standing but "removed" from

the commercial forest land classification by land use change — examples are removals from cultural operations such as timber stand improvement work, land clearing, and changes in land use.

Timber removals from sawtimber. — The net board-foot volume of live sawtimber trees removed for forest products annually (including roundwood products and logging residues) and for other removals.

Timber products output. — All timber products cut from roundwood, and byproducts of wood manufacturing plants. Roundwood products include logs, bolts, or other round sections cut from growing-stock trees, cull trees, salvable dead trees, trees on nonforest land, noncommercial species, sapling-size trees, and limbwood. Byproducts from primary manufacturing plants include slabs, edgings, trimmings, miscuts, sawdust, shavings, veneer cores and clippings, and pulpmill screenings that are used as pulpwood chips or other products.

Plant byproducts. — Plant residues used for products such as mulch, pulp chips, and fuelwood.

Plant residues. — Wood and bark materials generated at manufacturing plants during production of other products.

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Species	Growing stock		Sawtimber	
	[1/] 1962	1977	[1/] 1962	1977
	Thousand cubic feet		[2/] Thousand board feet	
SOFTWOODS				
White pine	191,796	194,797	900,060	1,068,372
Red pine	325,301	434,556	1,530,249	1,952,896
Jack pine	733,320	593,704	1,402,842	1,566,444
Spruce	813,347	717,920	849,704	1,109,131
Balsam fir	765,270	893,608	791,442	1,338,249
Tamarack	302,558	250,589	281,500	346,508
Northern white-cedar	251,867	387,215	376,843	1,142,761
Other softwoods	--	4,618	--	6,228
Total	3,383,459	3,477,007	6,132,640	8,530,589
HARDWOODS				
White oak	278,877	358,272	817,696	1,076,044
Red oak	433,424	581,563	1,027,215	1,820,036
Yellow birch	13,904	10,611	63,839	39,926
Hard maple	134,865	189,024	455,532	489,619
Soft maple	94,429	131,845	232,890	281,999
Ash	426,107	538,086	758,002	993,952
Paper birch	841,822	1,273,982	491,034	1,234,388
Aspen	2,790,752	3,410,720	2,208,044	5,974,671
Basswood	239,667	402,424	719,073	1,116,835
Elm	341,740	431,437	1,257,911	1,607,307
Other hardwoods	464,614	649,026	710,952	1,441,832
Total	6,060,201	7,976,990	8,742,188	16,076,609
All species	9,443,660	11,453,997	14,874,828	24,607,198

[1/] Figures have been adjusted from those published after the 1962 survey to conform to 1977 volumes because of changes in survey definitions and procedures.

[2/] International 1/4-inch rule.

Table 6.--Cubic foot volume in all live trees on commercial forest land by species group and diameter class, Minnesota, 1977

(In thousand cubic feet)

Species	All classes	Diameter class (inches at breast height) 5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-28.9	29.0-38.9	39.0+
SOFTWOODS													
White pine	205,023	7,642	9,141	22,103	15,544	22,314	28,626	29,505	16,398	16,236	30,644	6,552	318
Red pine	437,926	25,560	50,642	56,305	56,198	60,473	64,893	58,162	30,079	25,080	10,207	327	--
Jack pine	619,448	100,012	173,666	157,527	113,540	46,410	22,888	3,727	1,112	396	170	--	--
White spruce	183,887	24,023	25,736	30,613	31,104	24,622	21,153	12,044	8,332	3,956	2,304	--	--
Black spruce	552,013	266,807	171,833	78,841	21,044	8,904	2,778	1,069	685	52	--	--	--
Balsam fir	937,200	323,402	296,481	186,037	86,750	29,843	9,451	4,672	322	242	--	--	--
Tamarack	277,608	107,291	88,212	47,286	24,004	7,410	2,402	812	96	--	95	--	--
Northern white-cedar	463,876	84,543	106,085	99,802	74,301	47,050	26,702	13,924	7,513	2,136	1,713	107	--
Other softwoods	5,945	2,051	1,534	846	657	361	201	63	158	74	--	--	--
Total	3,682,926	941,331	923,330	679,360	423,142	247,387	179,094	123,978	64,695	48,172	45,133	6,986	318
HARDWOODS													
Select white oak	414,782	44,857	58,800	67,455	65,416	52,418	44,138	26,149	19,917	12,956	18,498	3,788	390
Select red oak	628,225	51,581	94,520	108,368	97,333	85,856	64,822	46,732	29,555	20,466	23,471	5,286	235
Other red oak	13,844	453	702	1,074	1,232	1,743	2,453	1,876	1,406	1,185	1,653	67	--
Hickory	17,210	3,191	3,246	3,674	2,824	2,307	1,028	420	397	123	--	--	--
Yellow birch	18,196	1,335	1,710	1,704	3,227	2,803	1,791	1,874	893	947	1,855	57	--
Hard maple	263,723	50,307	42,078	46,499	33,412	34,086	23,707	16,377	8,428	3,638	4,831	295	65
Soft maple	171,993	47,787	37,694	22,744	16,254	11,814	9,513	6,730	4,119	2,663	5,690	4,100	2,885
Ash	585,894	135,853	145,970	127,276	77,422	48,013	28,294	10,222	5,767	2,667	3,542	574	294
Balsam poplar	598,970	88,420	141,475	141,920	110,400	63,090	32,721	13,196	4,533	1,344	1,662	172	37
Paper birch	1,416,500	362,655	446,212	320,088	166,257	70,803	31,720	10,298	6,306	1,477	684	--	--
Bigtooth aspen	201,225	20,348	48,333	54,754	37,974	21,471	10,378	5,299	1,771	853	44	--	--
Quaking aspen	3,782,905	540,038	934,303	974,591	709,965	360,902	160,098	65,698	24,249	8,332	4,704	25	--
Basswood	442,931	49,939	80,985	80,692	69,324	51,440	39,635	27,161	18,229	10,168	12,325	2,703	330
Elm	485,879	37,657	53,695	61,411	58,300	52,447	50,973	44,231	29,745	25,012	44,323	21,562	6,523
Select hardwoods	22,911	4,006	3,310	4,002	3,665	2,512	2,501	1,419	412	216	556	312	--
Other hardwoods	80,832	8,255	10,115	10,718	9,590	7,480	6,249	4,935	3,921	4,136	4,540	5,872	5,021
Noncommercial species	16,884	7,794	4,774	1,783	1,046	557	436	135	197	--	65	97	--
Total	9,162,904	1,454,476	2,107,922	2,028,753	1,463,641	869,742	510,457	282,752	159,845	96,183	128,443	44,910	15,780
All species	12,845,830	2,395,807	3,031,252	2,708,113	1,886,783	1,117,129	689,551	406,730	224,540	144,355	173,576	51,896	16,098

Table 7.--Net volume of timber on commercial forest land by class of timber and softwoods and hardwoods, Minnesota, 1977

(In thousand cubic feet)

Class of timber	All species	Softwoods	Hardwoods
GROWING-STOCK TREES			
Saw log trees			
Saw log portion	3,499,363	1,292,396	2,206,967
Upper stem portion	1,232,785	426,209	806,576
Subtotal	4,732,148	1,718,605	3,013,543
Poletimber	6,721,849	1,758,402	4,963,447
Total	11,453,997	3,477,007	7,976,990
CULL TREES			
Rough and rotten cull trees			
Sawtimber	473,416	72,602	400,814
Poletimber	733,960	106,257	627,703
Subtotal	1,207,376	178,859	1,028,517
Short-log cull trees			
Sawtimber	184,457	27,060	157,397
Poletimber	--	--	--
Subtotal	184,457	27,060	157,397
Total	1,391,833	205,919	1,185,914
SALVABLE DEAD TREES	107,031	47,856	59,175
All classes	12,952,861	3,730,782	9,222,079

Table 8.--Net volume of growing stock and sawtimber on commercial forest land by county and species category, Minnesota, 1977

County	Growing stock						Sawtimber					
	All species	Pine	Spruce-fir	Other softwoods	Aspen	Other hardwoods	All species	Pine	Spruce-fir	Other softwoods	Aspen	Other hardwoods
	Thousand cubic feet						Thousand board feet[1/]					
ASPEN-BIRCH												
Carlton	210,376	18,849	25,747	8,117	57,322	100,341	347,958	91,996	37,529	10,104	62,312	146,017
Cook	534,017	33,526	179,850	31,744	171,395	117,502	1,083,698	136,545	313,513	116,398	400,505	116,737
Koochiching	928,923	43,462	271,210	135,430	262,888	215,933	1,594,444	145,029	308,582	330,176	387,920	422,737
Lake	694,029	59,566	165,030	54,112	158,441	256,880	1,466,852	253,984	246,627	199,397	366,035	400,809
St. Louis	2,154,730	295,927	474,006	92,359	736,692	555,746	3,831,644	1,074,438	677,313	199,597	1,187,494	692,802
Total	4,522,075	451,330	1,115,843	321,762	1,386,738	1,246,402	8,324,596	1,701,992	1,583,564	855,672	2,404,266	1,779,102
NORTHERN PINE												
Aitkin	487,614	8,372	36,300	34,082	123,423	285,437	1,039,872	38,096	63,867	60,083	251,714	626,112
Becker	305,068	33,278	14,819	7,191	107,449	142,331	620,361	108,439	35,053	15,581	153,771	307,517
Beltrami	683,735	105,002	67,283	71,526	213,220	226,704	1,407,730	402,218	102,768	98,078	387,647	417,019
Cass	854,270	186,144	64,160	34,964	274,528	294,474	2,027,912	782,239	128,207	85,317	564,796	467,353
Clearwater	266,797	21,628	15,774	11,151	100,995	117,249	521,323	98,311	27,623	28,683	148,506	218,200
Crow Wing	327,167	58,342	5,903	5,501	109,000	148,421	592,708	163,761	7,621	10,789	195,735	214,802
Hubbard	344,524	89,758	13,271	5,252	147,637	88,606	608,538	270,562	31,813	12,934	199,544	93,685
Itasca	1,297,155	157,615	225,932	77,632	426,676	409,300	2,987,983	703,993	395,196	202,778	942,958	743,058
Lake of the Woods	192,801	27,116	29,604	28,461	58,679	48,941	334,578	66,212	32,034	44,231	98,880	93,221
Mahnomen	91,371	1,495	589	1,067	29,118	59,102	168,247	2,764	1,730	3,829	47,271	112,653
Roseau	99,416	16,466	9,369	13,351	29,068	31,162	183,368	53,389	15,509	22,931	43,336	48,203
Wadena	72,976	28,992	881	1,183	22,466	19,454	128,130	62,728	2,838	--	22,387	40,177
Total	5,022,894	734,208	483,885	291,361	1,642,259	1,871,181	10,620,750	2,752,712	844,259	585,234	3,056,545	3,382,000
CENTRAL HARDWOOD												
Anoka	28,414	821	52	747	2,202	24,592	105,665	2,481	97	1,565	3,605	97,917
Benton	22,075	1,271	61	145	2,758	17,840	73,720	2,356	140	382	4,949	65,893
Carver	9,221	111	9	154	487	8,460	38,303	548	19	326	846	36,564
Chisago	39,317	1,511	238	1,364	3,960	32,244	136,656	3,134	411	2,800	6,908	123,403
Dakota	13,381	285	65	606	1,367	11,058	45,496	1,125	119	1,060	2,465	40,727
Douglas	12,281	235	65	321	2,208	9,452	35,423	990	168	762	3,094	30,409
Fillmore	54,832	1,219	19	354	5,949	47,291	183,563	5,213	73	696	8,751	168,830
Goodhue	52,365	805	40	397	4,440	46,683	182,049	2,902	94	723	7,397	170,933
Hennepin	6,455	76	12	168	394	5,805	26,870	346	22	335	768	25,399
Houston	106,619	801	32	273	6,244	99,269	392,741	3,560	111	493	10,500	378,077
Isanti	32,797	2,251	283	1,713	3,942	24,608	97,605	3,595	410	3,703	5,974	83,923
Kanabec	101,060	1,857	678	2,204	26,220	70,101	255,196	8,055	1,074	4,898	40,544	200,625
Le Sueur	9,030	89	20	270	520	8,131	36,716	365	36	537	978	34,800
Mille Lacs	95,532	1,542	674	2,179	22,976	68,161	247,242	6,523	1,080	4,664	37,573	197,402
Morrison	115,167	3,027	271	2,372	14,803	94,694	366,219	10,483	496	5,165	22,511	327,564
Olmsted	26,266	596	8	221	2,572	22,869	91,348	2,685	30	462	3,781	84,390
Otter Tail	140,234	3,191	1,217	2,974	35,703	97,149	345,069	12,702	2,084	5,992	56,778	267,513
Pine	299,170	11,035	6,434	7,574	107,800	166,327	588,231	38,601	9,162	10,393	162,088	367,987
Ramsey	--	--	--	--	--	--	--	--	--	--	--	--
Rice	10,778	83	33	148	820	9,694	44,855	391	100	332	1,448	42,584
Scott	12,340	123	16	234	589	11,378	51,873	581	39	491	1,065	49,697
Sherburne	48,087	1,586	268	543	3,543	42,147	167,266	3,911	265	454	5,591	157,045
Stearns	49,181	723	77	349	4,286	43,746	178,922	3,413	177	706	8,040	166,586
Todd	77,260	1,154	421	1,416	14,058	60,211	222,937	4,840	1,111	3,155	22,988	190,843
Wabasha	48,661	900	31	506	5,049	42,175	162,174	3,807	87	1,012	7,774	149,494
Washington	8,726	96	40	336	779	7,475	34,426	394	43	557	1,374	32,058
Winona	100,794	908	24	231	6,915	92,716	360,560	3,885	85	394	11,370	344,826
Wright	26,773	439	85	362	3,913	21,974	82,629	1,855	230	828	6,222	73,494
Total	1,546,816	36,735	11,173	28,161	284,497	1,186,250	4,553,754	128,741	17,763	52,885	445,382	3,908,983

(Table 8 continued on next page)

(Table 8 continued)

PRAIRIE

County	Growing stock						Sawtimber					
	All species	Pine	Spruce-fir	Other softwoods	Aspen	Other hardwoods	All species	Pine	Spruce-fir	Other softwoods	Aspen	Other hardwoods
	Thousand cubic feet						Thousand board feet[1/]					
Big Stone	1,574	--	--	2	282	1,290	5,317	--	--	5	225	5,087
Blue Earth	19,767	--	2	93	983	18,689	88,482	--	8	135	844	87,495
Brown	8,526	--	--	66	469	7,991	37,925	--	--	96	465	37,364
Chippewa	2,438	--	--	5	487	1,946	7,575	--	--	10	415	7,150
Clay	7,296	--	12	8	1,435	5,841	23,101	--	68	16	835	22,182
Cottonwood	2,153	--	--	--	382	1,771	7,863	--	--	--	363	7,500
Dodge	6,136	--	--	69	162	5,905	28,198	--	--	100	136	27,962
Faribault	5,608	--	--	6	446	5,156	24,300	--	--	9	430	23,861
Freeborn	4,339	--	2	43	221	4,073	19,191	--	8	64	134	18,985
Grant	2,715	--	--	1	461	2,253	9,536	--	--	2	249	9,285
Jackson	1,958	--	--	3	207	1,748	7,902	--	--	4	180	7,718
Kandiyohi	7,947	--	3	57	709	7,178	33,130	--	17	85	592	32,436
Kittson	32,021	296	114	106	16,958	14,547	44,047	1,614	137	194	10,077	32,025
Lac qui Parle	3,580	--	1	2	480	3,097	14,047	--	9	3	468	13,567
Lincoln	1,867	--	--	9	230	1,628	7,511	--	--	13	203	7,295
Lyon	3,485	--	--	10	359	3,116	14,137	--	--	15	325	13,797
McLeod	5,839	--	--	1	310	5,528	26,304	--	--	1	210	26,093
Marshall	63,118	371	283	207	29,098	33,159	111,282	2,021	687	293	18,437	89,844
Martin	3,085	--	--	1	521	2,563	11,394	--	--	1	468	10,925
Meeker	9,998	--	--	31	208	9,759	47,438	--	--	44	173	47,221
Mower	4,959	--	--	46	204	4,709	22,417	--	--	66	175	22,176
Murray	790	--	--	--	72	718	3,197	--	--	1	61	3,135
Nicollet	11,490	--	1	20	601	10,868	52,093	--	8	28	575	51,482
Nobles	523	--	--	--	135	388	1,553	--	--	1	115	1,437
Norman	15,448	11	19	11	5,353	10,054	39,652	61	86	19	4,235	35,251
Pennington	20,227	37	41	20	8,665	11,464	43,803	199	165	35	6,607	36,797
Pipestone	382	--	--	3	69	310	1,338	--	--	4	59	1,275
Polk	48,740	38	99	69	14,344	34,190	144,142	208	452	107	10,790	132,585
Pope	4,762	2	10	31	1,120	3,599	14,027	8	6	36	905	13,072
Red Lake	17,932	29	29	34	8,048	9,792	36,804	156	110	55	6,257	30,226
Redwood	4,783	--	3	31	668	4,081	17,862	--	17	45	547	17,253
Renville	6,586	--	6	37	584	5,959	27,371	--	8	48	543	26,772
Rock	319	--	--	1	49	269	1,054	--	--	1	42	1,011
Sibley	10,382	--	--	51	562	9,769	46,617	--	--	73	437	46,107
Steele	4,560	--	2	24	283	4,251	20,074	--	8	35	202	19,829
Stevens	741	--	--	--	184	557	2,389	--	--	1	120	2,268
Swift	3,494	--	--	7	639	2,848	12,142	--	--	10	493	11,639
Traverse	509	--	--	2	107	400	1,477	--	--	3	91	1,383
Waseca	4,007	--	--	10	166	3,831	18,469	--	--	15	156	18,298
Watonwan	897	--	--	--	19	878	4,240	--	--	--	52	4,188
Wilkin	225	--	--	1	65	159	537	--	--	1	32	504
Yellow Medicine	7,006	--	--	20	881	6,105	28,157	--	--	30	754	27,373
Total	362,212	784	627	1,138	97,226	262,437	1,108,095	4,267	1,794	1,704	68,477	1,031,853
All units	11,453,997	1,223,057	1,611,528	642,422	3,410,720	4,566,270	24,607,195	4,587,712	2,447,380	1,495,495	5,974,670	10,101,938

[1/] International 1/4-inch rule.

Table 9.--Net volume of growing stock, sawtimber, short-log, and rough and rotten trees on commercial forest land by individual species, Minnesota, 1977

Species	Total all live	Growing stock	Short-log	Rough and rotten	Sawtimber
	- - - - - - -Thousand cubic feet- - - - - - -				Thousand board feet[1/]
SOFTWOODS					
White pine	205,023	194,797	1,729	8,497	1,068,372
Red pine	437,926	434,556	785	2,585	1,952,896
Jack pine	619,449	593,704	4,109	21,636	1,566,444
Scotch pine	1,165	1,036	--	129	1,666
White spruce	183,887	180,969	264	2,654	648,730
Black spruce	552,013	536,951	1,208	13,854	460,401
Balsam fir	937,200	893,608	4,229	39,363	1,338,249
Tamarack	277,608	250,589	2,462	24,557	346,508
Northern white-cedar	463,876	387,215	11,883	64,778	1,142,761
Eastern redcedar	4,779	3,582	391	806	4,562
Total	3,682,926	3,477,007	27,060	178,859	8,530,589
HARDWOODS					
White oak	65,467	54,086	3,761	7,620	204,223
Bur oak	349,191	304,186	12,310	32,695	871,821
Swamp white oak	124	--	--	124	--
Northern red oak	628,225	568,939	13,346	45,940	1,763,622
Black oak	2,734	2,372	--	362	10,525
Northern pin oak	11,110	10,252	385	473	45,889
Bitternut hickory	5,294	5,211	--	83	6,798
Shagbark hickory	11,916	11,207	200	509	25,585
Yellow birch	18,196	10,611	2,057	5,528	39,926
Sugar maple	262,890	188,534	10,015	64,341	487,955
Black maple	833	490	--	343	1,664
Red maple	134,415	100,171	1,519	32,725	110,402
Silver maple	37,578	31,674	1,869	4,035	171,596
White ash	2,809	2,349	--	460	10,239
Black ash	485,614	449,732	4,003	31,879	727,731
Green ash	97,471	86,005	1,364	10,102	255,982
Balsam poplar	598,970	548,624	5,239	45,107	1,101,406
Paper birch	1,416,500	1,273,982	11,929	130,589	1,234,388
Bigtooth aspen	201,225	174,315	3,398	23,512	303,391
Quaking aspen	3,782,905	3,236,405	60,256	486,244	5,671,280
Basswood	442,931	402,424	7,295	33,212	1,116,835
American elm	449,804	398,468	14,725	36,611	1,461,780
Slippery elm	31,155	28,681	465	2,009	129,165
Rock elm	4,920	4,288	104	528	16,362
Butternut	7,659	5,575	354	1,730	13,357
Black walnut	5,071	4,686	124	261	13,690
Black cherry	10,181	8,055	11	2,115	13,145
Boxelder	33,332	22,203	1,133	9,996	53,725
River birch	504	300	73	131	289
Hackberry	4,142	3,585	242	315	14,923
Eastern cottonwood	23,205	21,589	887	729	117,565
Black willow	19,076	17,561	257	1,258	80,118
Kentucky coffeetree	573	430	76	67	1,231
Noncommercial	16,884	--	--	16,884	--
Total	9,162,904	7,976,990	157,397	1,028,517	16,076,608
All species	12,845,830	11,453,997	184,457	1,207,376	24,607,197

[1/] International 1/4-inch rule.

Table 10.--Net volume of growing stock on commercial forest land by species group and Forest Survey Unit, Minnesota, 1977

(In thousand cubic feet)

Species	All units	Aspen-Birch	Northern Pine	Central Hardwood	Prairie
SOFTWOODS					
White pine	194,797	91,561	90,495	12,741	--
Red pine	434,556	147,197	273,024	13,843	492
Jack pine	593,704	212,572	370,689	10,151	292
White spruce	180,969	136,485	42,389	1,705	390
Black spruce	536,951	419,971	113,362	3,555	63
Balsam fir	893,608	559,387	328,134	5,913	174
Tamarack	250,589	75,063	150,313	24,900	313
Northern white-cedar	387,215	246,561	140,654	--	--
Other softwoods	4,618	138	394	3,261	825
Total	3,477,007	1,888,935	1,509,454	76,069	2,549
HARDWOODS					
Select white oak	358,272	5,277	119,986	172,960	60,049
Select red oak	568,939	9,347	217,524	326,516	15,552
Other red oak	12,624	--	1,015	11,087	522
Hickory	16,418	--	520	15,522	376
Yellow birch	10,611	6,861	3,552	198	--
Hard maple	189,024	43,352	83,680	54,508	7,484
Soft maple	131,845	38,495	49,757	40,258	3,335
Ash	538,086	196,644	241,200	76,509	23,733
Balsam poplar	548,624	244,477	265,529	12,839	25,779
Paper birch	1,273,982	620,775	538,764	111,395	3,048
Bigtooth aspen	174,315	21,001	123,016	30,271	27
Quaking aspen	3,236,405	1,365,737	1,519,243	254,226	97,199
Basswood	402,424	35,262	203,813	133,839	29,510
Elm	431,437	45,431	141,808	185,338	58,860
Select hardwoods	18,316	53	2,005	14,303	1,955
Other hardwoods	65,668	428	2,028	30,978	32,234
Noncommercial species	--	--	--	--	--
Total	7,976,990	2,633,140	3,513,440	1,470,747	359,663
All species	11,453,997	4,522,075	5,022,894	1,546,816	362,212

Table 11.--Net volume of sawtimber on commercial forest land by species group and Forest Survey Unit, Minnesota, 1977

(In thousand board feet)[1/]

Species	All units	Aspen-Birch	Northern Pine	Central Hardwood	Prairie
SOFTWOODS:					
White pine	1,068,372	515,487	489,804	63,081	--
Red pine	1,952,896	596,918	1,310,295	42,516	3,167
Jack pine	1,566,444	589,587	952,613	23,144	1,100
White spruce	648,730	471,316	168,448	7,172	1,794
Black spruce	460,401	371,239	87,515	1,647	--
Balsam fir	1,338,249	741,009	588,296	8,944	--
Tamarack	346,508	86,831	210,950	48,280	447
Northern white-cedar	1,142,761	768,841	373,920	--	--
Other softwoods	6,228	--	364	4,605	1,259
Total	8,530,589	4,141,228	4,182,205	199,389	7,767
HARDWOODS:					
Select white oak	1,076,044	13,774	264,498	570,892	226,880
Select red oak	1,763,622	23,285	439,583	1,237,647	63,107
Other red oak	56,414	--	1,141	52,870	2,403
Hickory	32,383	--	444	31,088	851
Yellow birch	39,926	27,091	11,866	969	--
Hard maple	489,619	56,909	204,393	198,945	29,372
Soft maple	281,998	30,931	75,450	158,376	17,241
Ash	993,952	312,399	352,993	227,791	100,769
Balsam poplar	1,101,406	481,135	572,553	18,664	29,054
Paper birch	1,234,388	591,221	570,799	69,492	2,876
Bigtooth aspen	303,391	32,683	213,453	57,255	--
Quaking aspen	5,671,280	2,371,583	2,843,092	388,128	68,477
Basswood	1,116,835	64,530	413,860	489,971	148,474
Elm	1,607,307	176,959	468,485	691,004	270,859
Select hardwoods	40,192	--	2,223	32,630	5,339
Other hardwoods	267,851	868	3,712	128,643	134,628
Noncommercial species	--	--	--	--	--
Total	16,076,608	4,183,368	6,438,545	4,354,365	1,100,330
All species	24,607,197	8,324,596	10,620,750	4,553,754	1,108,097

[1/] International 1/4-inch rule.

Table 12.--Net volume of growing stock on commercial forest land by species group and diameter class, Minnesota, 1977

(In thousand cubic feet)

Species	All classes	Diameter class (inches at breast height) 5.0-6.9	7.0-8.9	9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-28.9	29.0-38.9	39.0+
SOFTWOODS													
White pine	194,797	6,149	7,815	20,429	14,865	21,769	26,433	29,044	16,165	15,782	29,836	6,192	318
Red pine	434,556	24,844	49,880	55,803	55,778	60,043	64,893	57,934	29,903	25,005	10,158	315	--
Jack pine	593,704	95,316	166,977	151,777	109,695	43,944	21,196	3,499	734	396	170	--	--
White spruce	180,969	23,613	24,773	29,975	30,605	24,510	21,072	11,881	8,281	3,955	2,304	--	--
Black spruce	536,951	258,093	168,191	76,734	20,653	8,862	2,612	1,069	685	52	--	--	--
Balsam fir	893,608	305,998	285,790	177,026	83,296	28,282	8,862	3,789	323	242	--	--	--
Tamarack	250,589	95,661	80,677	42,818	21,901	6,692	2,150	595	--	--	95	--	--
Northern white-cedar	387,215	70,403	90,957	82,057	60,214	39,889	22,618	11,559	6,307	1,658	1,462	91	--
Other softwoods	4,618	1,751	1,515	559	591	132	70	--	--	--	--	--	--
Total	3,477,007	881,828	876,575	637,178	397,598	234,123	169,906	119,370	62,398	47,090	44,025	6,598	318
HARDWOODS													
Select white oak	358,272	40,856	53,466	61,660	56,973	46,495	36,325	21,257	16,177	9,728	12,586	2,359	390
Select red oak	568,939	46,756	88,659	101,481	88,002	77,602	57,935	41,582	25,635	17,550	19,538	4,012	187
Other red oak	12,624	404	676	1,005	1,189	1,453	2,453	1,737	1,185	826	1,628	68	--
Hickory	16,418	3,090	3,191	3,592	2,713	2,077	918	384	330	123		--	--
Yellow birch	10,611	874	951	732	2,119	1,623	1,187	1,262	774	450	639	--	--
Hard maple	189,024	41,911	32,145	30,538	23,155	23,212	16,150	11,876	4,794	1,952	3,166	60	65
Soft maple	131,845	40,366	27,996	16,470	12,622	9,181	6,509	4,818	2,845	1,920	4,449	2,694	1,975
Ash	538,086	125,386	135,624	116,819	70,105	44,109	25,857	9,037	5,336	2,275	2,806	438	294
Balsam poplar	548,624	79,004	129,510	131,819	103,339	57,647	29,877	11,009	3,930	863	1,454	172	--
Paper birch	1,273,982	325,598	406,838	291,766	147,840	61,949	25,675	7,906	5,092	901	417	--	--
Bigtooth aspen	174,315	17,677	43,195	49,705	32,880	17,052	8,190	4,056	1,009	551	--	--	--
Quaking aspen	3,236,405	470,750	820,817	854,070	607,753	294,792	121,463	43,802	14,986	4,900	3,072	--	--
Basswood	402,424	44,906	75,355	74,498	62,992	46,707	35,977	24,444	16,578	8,772	9,931	2,078	186
Elm	431,437	35,234	49,769	54,498	52,357	46,789	46,464	40,376	26,398	21,716	37,658	15,916	4,262
Select hardwoods	18,316	2,936	2,699	3,480	3,079	1,954	2,215	1,213	287	169	284	--	--
Other hardwoods	65,668	6,856	8,450	9,368	7,664	5,799	4,916	3,985	3,212	3,080	3,215	4,883	4,240
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	7,976,990	1,282,604	1,879,341	1,801,501	1,274,782	738,441	422,111	228,744	128,568	75,776	100,843	32,680	11,599
All species	11,453,997	2,164,432	2,755,916	2,438,679	1,672,380	972,564	592,017	348,114	190,966	122,866	144,868	39,278	11,917

Table 13.--Net volume of sawtimber on commercial forest land by species group and diameter class, Minnesota, 1977

(In thousand board feet)[1/]

Species	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-28.9	29.0-38.9	39.0+
SOFTWOODS											
White pine	1,068,372	121,360	93,477	130,950	153,745	167,250	94,677	91,464	175,759	37,359	2,331
Red pine	1,952,896	261,711	288,634	312,921	346,863	329,144	178,336	160,738	71,378	3,171	--
Jack pine	1,566,444	725,404	506,640	205,290	106,429	16,547	3,364	1,991	779	--	--
White spruce	648,730	126,383	140,116	124,198	110,760	64,162	47,201	22,178	13,732	--	--
Black spruce	460,401	307,934	89,418	40,786	12,564	5,568	3,539	592	--	--	--
Balsam fir	1,338,249	784,954	369,426	124,454	39,333	17,287	1,430	1,365	--	--	--
Tamarack	346,508	198,533	102,284	31,041	10,570	3,160	--	--	920	--	--
Northern white-cedar	1,142,761	421,477	301,268	197,974	110,762	57,344	34,045	9,943	9,091	857	--
Other softwoods	6,228	2,927	2,549	477	275	--	--	--	--	--	--
Total	8,530,589	2,950,683	1,893,812	1,168,091	891,301	660,462	362,592	288,271	271,659	41,387	2,331
HARDWOODS											
Select white oak	1,076,044	--	301,831	247,911	194,992	111,213	86,100	52,070	67,403	12,488	2,036
Select red oak	1,763,622	--	455,970	412,745	311,706	223,639	137,318	94,558	105,549	21,036	1,101
Other red oak	56,414	--	6,441	7,692	12,915	9,459	6,387	4,386	8,729	405	--
Hickory	32,383	--	13,211	11,226	4,312	1,637	1,473	524	--	--	--
Yellow birch	39,926	--	10,374	8,443	6,651	6,202	3,717	1,958	2,581	--	--
Hard maple	489,619	--	134,596	132,811	92,012	70,081	29,254	11,626	18,315	470	454
Soft maple	281,998	--	73,576	59,117	40,986	30,231	18,306	11,982	25,173	13,747	8,880
Ash	993,952	--	440,293	271,984	152,502	58,515	33,079	15,803	17,839	2,432	1,505
Balsam poplar	1,101,406	--	534,789	307,661	161,412	60,691	21,563	4,900	9,653	737	--
Paper birch	1,234,388	--	742,689	305,074	121,115	38,016	21,772	4,017	1,705	--	--
Bigtooth aspen	303,391	--	154,814	81,851	39,560	19,260	4,866	3,040	--	--	--
Quaking aspen	5,671,280	--	3,179,633	1,518,668	631,756	221,601	77,557	25,103	16,962	--	--
Basswood	1,116,835	--	325,520	249,097	197,069	136,234	92,959	48,423	55,294	11,341	898
Elm	1,607,307	--	297,358	261,745	254,321	217,866	144,202	116,545	206,103	85,529	23,638
Select hardwoods	40,192	--	11,670	7,999	9,490	6,600	1,679	1,182	1,572	--	--
Other hardwoods	267,851	--	59,151	41,930	35,418	27,639	20,634	18,969	18,708	25,120	20,282
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--
Total	16,076,608	--	6,741,916	3,925,954	2,266,217	1,238,884	700,866	415,086	555,586	173,305	58,794
All species	24,607,197	2,950,683	8,635,728	5,094,045	3,157,518	1,899,346	1,063,458	703,357	827,245	214,692	61,125

[1/] International 1/4-inch rule.

Table 14.--Net volume of growing stock on commercial forest land by species group and forest type, Minnesota, 1977

(In thousand cubic feet)

Species	All types	Forest type						
		Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar
SOFTWOODS								
White pine	194,797	2,788	45,377	52,529	11,887	1,009	2,787	2,631
Red pine	434,556	38,735	251,343	16,619	12,406	1,119	1,839	3,477
Jack pine	593,704	435,520	16,837	5,630	6,558	2,506	15,145	1,862
White spruce	180,969	2,337	4,222	6,694	34,120	20,094	8,614	2,363
Black spruce	536,951	16,129	1,403	803	54,748	1,244	342,917	38,975
Balsam fir	893,608	5,764	14,921	3,850	299,047	4,765	29,742	33,255
Tamarack	250,589	125	281	--	11,015	624	37,677	11,725
Northern white-cedar	387,215	--	312	211	42,370	1,760	10,264	235,540
Other softwoods	4,618	--	589	--	--	--	184	--
Total	3,477,007	501,398	335,285	86,336	472,151	33,121	449,169	329,828
HARDWOODS								
Select white oak	358,272	854	226	623	613	29	--	--
Select red oak	568,939	2,628	1,037	571	152	--	197	--
Other red oak	12,624	--	--	--	--	--	--	--
Hickory	16,418	--	--	--	--	--	--	--
Yellow birch	10,611	--	--	--	308	--	--	715
Hard maple	189,024	--	--	221	607	--	--	--
Soft maple	131,845	1,334	56	870	2,426	--	286	57
Ash	538,086	64	129	345	8,550	--	2,115	9,017
Balsam poplar	548,624	579	559	46	19,671	722	1,110	6,635
Paper birch	1,273,982	11,385	24,693	4,421	93,342	8,572	7,902	24,318
Bigtooth aspen	174,315	3,248	2,887	37	789	--	311	516
Quaking aspen	3,236,405	38,439	14,328	10,143	77,556	7,516	32,326	7,309
Basswood	402,424	63	--	465	1,448	--	--	--
Elm	431,437	124	43	--	1,530	--	79	172
Select hardwoods	18,316	--	--	--	--	--	--	--
Other hardwoods	65,668	225	118	--	--	--	--	--
Noncommercial species	--	--	--	--	--	--	--	--
Total	7,976,990	58,943	44,076	17,742	206,992	16,839	44,326	48,739
All species	11,453,997	560,341	379,361	104,078	679,143	49,960	493,495	378,567

(Table 14 continued on next page)

(Table 14 continued)

Species	Forest type							
	Tamarack	Oak hickory	Elm-ash-cottonwood	Maple-basswood	Aspen	Paper birch	Balsam poplar	Non-stocked
SOFTWOODS								
White pine	1,248	2,422	1,583	12,990	43,050	14,053	443	--
Red pine	514	6,075	322	766	75,167	25,865	309	--
Jack pine	1,047	6,565	442	1,700	87,605	9,032	1,162	2,093
White spruce	488	554	5,123	7,715	65,257	17,996	5,392	--
Black spruce	21,379	86	2,265	975	48,382	4,671	2,537	437
Balsam fir	3,478	577	35,475	42,678	292,578	84,111	39,590	3,777
Tamarack	161,129	214	3,179	2,566	11,872	4,983	4,371	828
Northern white-cedar	4,706	--	29,393	12,048	31,292	12,495	6,419	405
Other softwoods	--	2,275	89	1,019	45	296	121	--
Total	193,989	18,768	77,871	82,457	655,248	173,502	60,344	7,540
HARDWOODS								
Select white oak	--	186,573	7,989	64,565	85,978	8,692	1,924	206
Select red oak	197	345,887	1,118	66,373	120,485	29,402	892	--
Other red oak	--	9,034	317	1,774	1,296	69	134	--
Hickory	--	12,728	--	2,863	--	827	--	--
Yellow birch	--	--	1,814	6,110	250	1,185	229	--
Hard maple	--	5,497	1,901	147,695	23,019	8,550	1,430	104
Soft maple	253	5,064	28,823	34,196	40,287	17,832	361	--
Ash	424	9,393	267,189	95,747	98,957	24,632	20,901	623
Balsam poplar	2,308	1,949	21,942	16,858	231,042	23,691	221,373	139
Paper birch	3,135	44,595	28,129	81,071	448,945	467,891	24,200	1,383
Bigtooth aspen	--	11,001	1,233	9,597	135,755	8,588	353	--
Quaking aspen	2,604	53,146	22,274	85,594	2,697,885	124,144	59,467	3,674
Basswood	--	30,356	11,609	271,204	69,857	15,372	2,050	--
Elm	910	36,307	70,521	225,013	67,648	14,916	13,654	520
Select hardwoods	--	10,080	607	5,204	1,911	389	67	58
Other hardwoods	--	3,908	40,945	16,554	3,362	--	213	343
Noncommercial species	--	--	--	--	--	--		
Total	9,831	765,518	506,411	1,130,418	4,026,677	746,180	347,248	7,050
All species	203,820	784,286	584,282	1,212,875	4,681,925	919,682	407,592	14,590

Table 15.--Net volume of sawtimber on commercial forest land by species group and forest type, Minnesota, 1977

(In thousand board feet)[1/]

Species	All types	Forest type: Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar
SOFTWOODS								
White pine	1,068,372	10,856	237,978	289,021	72,837	6,649	16,097	16,202
Red pine	1,952,896	135,809	1,093,109	88,319	64,394	4,588	9,963	18,696
Jack pine	1,566,444	1,051,843	45,843	28,580	25,931	10,876	43,528	6,303
White spruce	648,730	4,381	13,789	29,458	125,019	65,686	26,213	8,914
Black spruce	460,401	11,469	998	1,192	79,000	1,404	180,844	64,052
Balsam fir	1,338,249	3,897	46,705	7,691	394,770	5,506	25,026	29,443
Tamarack	346,508	687	354	--	25,465	2,388	40,026	14,828
Northern white-cedar	1,142,761	--	1,101	428	132,944	7,411	17,620	619,635
Other softwoods	6,228	--	--	--	--	--	--	--
Total	8,530,589	1,218,942	1,439,877	444,689	920,360	104,508	359,317	778,073
HARDWOODS								
Select white oak	1,076,044	393	--	552	1,904	--	--	--
Select red oak	1,763,622	1,531	2,005	2,376	438	--	--	--
Other red oak	56,414	--	--	--	--	--	--	--
Hickory	32,383	--	--	--	--	--	--	--
Yellow birch	39,926	--	--	--	646	--	--	2,236
Hard maple	489,619	--	--	1,344	--	--	--	--
Soft maple	281,998	--	--	346	7,623	--	684	--
Ash	993,952	--	--	368	12,125	--	6,719	16,218
Balsam poplar	1,101,406	975	--	--	30,680	750	1,048	16,036
Paper birch	1,234,388	3,909	36,621	3,857	141,043	11,322	4,826	42,718
Bigtooth aspen	303,391	1,181	318	--	2,475	--	393	1,176
Quaking aspen	5,671,280	61,514	19,307	37,026	123,947	16,488	31,878	15,719
Basswood	1,116,835	--	--	1,296	4,582	--	--	--
Elm	1,607,307	424	--	--	4,617	--	--	762
Select hardwoods	40,192	--	--	--	--	--	--	--
Other hardwoods	267,851	--	--	--	--	--	--	--
Noncommercial species	--	--	--	--	--	--	--	--
Total	16,076,608	69,927	58,251	47,165	330,080	28,560	45,548	94,865
All species	24,607,197	1,288,869	1,498,128	491,854	1,250,440	133,068	404,865	872,938

[1/]International 1/4-inch rule.

(Table 15 continued on next page)

(Table 15 continued)

Species	Forest type							
	Tamarack	Oak hickory	Elm-ash-cottonwood	Maple-basswood	Aspen	Paper birch	Balsam poplar	Non-stocked
SOFTWOODS								
White pine	7,454	13,968	10,261	73,792	235,419	75,224	2,614	--
Red pine	2,293	27,070	1,128	4,353	365,963	135,609	1,602	--
Jack pine	2,655	18,743	1,214	7,218	284,213	32,953	896	5,648
White spruce	1,028	2,357	19,458	34,788	217,387	79,613	20,639	--
Black spruce	12,464	353	4,429	1,720	84,154	10,270	7,073	979
Balsam fir	4,453	493	59,563	94,096	459,104	125,661	71,838	10,003
Tamarack	177,555	1,101	7,247	6,685	36,068	14,748	17,602	1,754
Northern white-cedar	11,911	--	108,288	52,133	118,607	48,256	22,913	1,514
Other softwoods	--	4,039	364	1,825	--	--	--	--
Total	219,813	68,124	211,952	276,610	1,800,915	522,334	145,177	19,898
HARDWOODS								
Select white oak	--	601,375	29,402	237,231	181,871	17,761	4,879	676
Select red oak	1,082	1,165,499	926	247,767	273,100	65,337	3,561	--
Other red oak	--	42,719	1,718	9,021	2,231	--	725	--
Hickory	--	23,625	--	5,456	--	3,302	--	--
Yellow birch	--	--	7,306	24,162	463	4,218	895	--
Hard maple	--	14,787	4,913	435,094	26,390	6,490	601	--
Soft maple	--	9,080	148,521	79,370	31,582	4,792	--	--
Ash	--	20,987	467,143	278,329	127,516	31,683	30,240	2,624
Balsam poplar	4,939	4,350	64,585	49,547	449,184	52,074	427,238	--
Paper birch	2,416	29,524	44,761	145,752	358,611	370,387	37,849	792
Bigtooth aspen	--	29,064	2,877	29,072	219,687	17,148	--	--
Quaking aspen	3,989	94,318	53,728	198,888	4,572,282	307,130	128,498	6,568
Basswood	--	78,306	40,612	860,089	98,727	29,965	3,258	--
Elm	811	122,620	270,664	936,185	182,843	39,943	46,278	2,160
Select hardwoods	--	21,447	226	15,359	2,483	677	--	--
Other hardwoods	--	12,123	177,158	68,153	8,492	--	--	1,925
Noncommercial species	--	--	--	--	--	--	--	--
Total	13,237	2,269,824	1,314,540	3,619,475	6,535,462	950,907	684,022	14,745
All species	233,050	2,337,948	1,526,492	3,896,085	8,336,377	1,473,241	829,199	34,643

Table 16.--Net volume of growing stock on commercial forest land by species group and ownership class, Minnesota, 1977

(In thousand cubic feet)

Species	All owners	Ownership class											
		National Forest	Bureau of Land Mgmt.	Indian	Misc. Federal	State	County & municipal	Forest Industry	Farmer	Misc. priv.-corp.	Misc. priv.-indiv.	Misc. priv.-corp., leased	Misc. priv.-indiv., leased
SOFTWOODS													
White pine	194,797	76,561	448	12,675	1,408	15,003	23,886	10,787	30,214	5,395	17,446	--	974
Red pine	434,556	185,006	2,503	18,320	958	47,939	62,798	20,305	48,232	6,782	41,713	--	--
Jack pine	593,704	157,912	9,613	8,978	4,146	101,261	89,280	46,130	96,742	13,088	66,288	266	--
White spruce	180,969	49,247	1,360	5,073	1,675	30,138	32,968	16,341	18,331	5,793	19,919	124	--
Black spruce	536,951	106,720	3,591	17,903	3,708	221,824	67,696	42,303	31,201	15,852	25,800	353	--
Balsam fir	893,608	218,902	913	22,874	5,106	156,371	201,918	77,640	94,053	35,962	79,551	--	318
Tamarack	250,589	13,094	571	17,729	1,483	108,065	36,308	6,387	42,774	7,531	16,647	--	--
Northern white-cedar	387,215	63,624	3,815	33,043	1,667	136,637	51,746	45,148	19,439	7,474	24,622	--	--
Other softwoods	4,618	--	--	--	--	983	138	--	2,568	604	325	--	--
Total	3,477,007	871,066	22,814	136,595	20,151	818,221	566,738	265,041	383,554	98,481	292,311	743	1,292
HARDWOODS													
Select white oak	358,272	8,109	84	7,563	1,508	19,393	20,508	1,391	241,026	7,190	50,382	--	1,118
Select red oak	568,939	10,862	--	5,462	4,080	61,287	53,170	6,634	293,332	17,907	114,562	--	1,643
Other red oak	12,624	--	--	--	380	1,201	58	--	10,519	--	466	--	--
Hickory	16,418	--	--	191	327	246	300	--	14,067	--	1,287	--	--
Yellow birch	10,611	461	--	--	--	978	5,556	691	490	988	1,447	--	--
Hard maple	189,024	7,210	--	4,776	1,739	28,658	37,457	8,423	64,520	3,630	32,279	70	262
Soft maple	131,845	18,103	--	1,460	14,120	13,497	23,858	4,953	33,325	4,057	18,472	--	--
Ash	538,086	54,957	1,377	14,972	5,860	88,929	92,853	28,688	157,780	15,460	76,998	--	212
Balsam poplar	548,624	62,455	1,091	24,621	4,955	103,048	112,710	37,560	130,114	14,584	57,227	108	151
Paper birch	1,273,982	240,812	1,840	36,306	9,046	178,606	272,388	67,148	209,877	62,146	194,559	88	1,166
Bigtooth aspen	174,315	5,760	134	2,364	397	33,426	36,049	7,240	40,364	6,570	41,746	--	265
Quaking aspen	3,236,405	549,715	9,557	115,918	19,595	518,351	684,905	188,751	652,602	112,222	380,839	2,755	1,195
Basswood	402,424	28,068	--	15,616	3,468	33,974	59,554	9,707	168,628	11,643	70,441	--	1,325
Elm	431,437	13,488	480	8,672	6,698	36,215	45,670	9,776	243,085	7,539	57,562	--	2,252
Select hardwoods	18,316	--	--	--	139	1,873	403	--	13,411	696	1,794	--	--
Other hardwoods	65,668	--	--	62	4,106	4,259	118	--	49,515	958	6,650	--	--
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	7,976,990	1,000,000	14,563	237,983	76,418	1,123,941	1,445,557	370,962	2,322,655	265,590	1,106,711	3,021	9,589
All species	11,453,997	1,871,066	37,377	374,578	96,569	1,942,162	2,012,295	636,003	2,706,209	364,071	1,399,022	3,764	10,881

Table 17.--Net volume of sawtimber on commercial forest land by species group and ownership class, Minnesota, 1977

(In thousand board feet)[1/]

Species	All owners	Ownership class											
		National Forest	Bureau of Land Mgmt.	Indian	Misc. Federal	State	County & municipal	Forest Industry	Farmer	Misc. priv.-corp.	Misc. priv.-indiv.	Misc. priv.-corp., leased	Misc. priv.-indiv. leased
SOFTWOODS													
White pine	1,068,372	394,746	1,625	61,881	8,028.	88,087	135,016	71,963	168,052	31,346	103,315	--	4,313
Red pine	1,952,896	827,988	3,970	82,942	5,087	218,637	293,305	76,379	226,166	30,435	187,987	--	--
Jack pine	1,566,444	420,047	26,103	26,010	14,712	295,928	236,124	87,328	253,477	41,542	164,294	879	--
White spruce	648,730	183,093	7,353	20,503	5,391	91,818	118,397	55,945	73,495	22,259	70,008	468	--
Black spruce	460,401	139,187	2,280	7,237	4,580	163,130	51,093	43,448	19,058	10,444	19,944	--	--
Balsam fir	1,338,249	341,533	1,996	32,973	11,523	216,563	306,820	108,577	147,402	44,961	125,373	--	528
Tamarack	346,508	26,681	1,174	19,298	2,771	130,810	42,638	5,618	80,751	8,936	27,831	--	--
Northern white-cedar	1,142,761	217,274	6,376	57,153	6,510	383,199	165,677	147,545	45,783	28,493	84,751	--	--
Other softwoods	6,228	--	--	--	--	364	--	--	3,581	821	1,462	--	--
Total	8,530,589	2,550,549	50,877	307,997	58,602	1,588,536	1,349,070	596,803	1,017,765	219,237	784,965	1,347	4,841
HARDWOODS													
Select white oak	1,076,044	25,896	429	13,597	5,372	49,035	41,196	1,220	786,380	18,428	129,610	--	4,881
Select red oak	1,763,622	13,077	--	6,982	11,194	160,531	104,125	5,014	1,084,804	44,897	329,567	--	3,431
Other red oak	56,414	--	--	--	2,058	3,007	290	--	49,371	--	1,688	--	--
Hickory	32,383	--	--	--	637	285	989	--	29,539	--	933	--	--
Yellow birch	39,926	1,606	--	--	--	2,755	22,413	3,290	903	4,502	4,457	--	--
Hard maple	489,619	6,668	--	9,720	3,869	71,846	81,504	16,620	208,839	3,841	86,712	--	--
Soft maple	281,998	10,900	--	1,088	81,748	20,518	29,770	5,038	94,607	5,418	32,911	--	--
Ash	993,952	88,212	2,258	20,646	20,577	129,499	156,737	52,598	357,578	24,091	140,943	--	813
Balsam poplar	1,101,406	144,889	1,916	37,980	3,937	206,987	253,307	74,119	244,099	30,580	102,188	523	881
Paper birch	1,234,388	276,079	1,058	50,296	16,037	185,600	197,057	75,316	203,453	41,735	187,447	--	310
Bigtooth aspen	303,391	12,135	--	3,767	695	40,387	51,585	18,943	92,045	13,876	69,218	--	740
Quaking aspen	5,671,280	1,068,447	21,668	205,049	39,243	836,043	1,219,322	356,277	1,042,614	234,038	642,280	2,168	4,131
Basswood	1,116,835	36,841	--	33,986	8,114	83,137	106,332	15,521	588,125	27,875	210,393	--	6,511
Elm	1,607,307	55,474	1,777	23,756	28,484	117,399	151,743	37,656	942,695	25,310	212,793	--	10,220
Select hardwoods	40,192	--	--	--	440	3,129	--	--	30,534	1,591	4,498	--	--
Other hardwoods	267,851	--	--	304	22,293	14,959	--	--	204,298	3,026	22,971	--	--
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	16,076,608	1,740,224	29,106	407,171	244,698	1,925,117	2,416,370	661,612	5,959,884	479,208	2,178,609	2,691	31,918
All species	24,607,197	4,290,773	79,983	715,168	303,300	3,513,653	3,765,440	1,258,415	6,977,649	698,445	2,963,574	4,038	36,759

[1/]International 1/4-inch rule.

Table 18.--Net volume of growing stock on commercial forest land by forest type and stand-age class, Minnesota, 1977

(In thousand cubic feet)

Forest type	All classes	Stand-age class (years)					
		0-10	11-20	21-30	31-40	41-50	51-60
Jack pine	560,341	4,681	3,194	24,517	115,786	143,135	147,803
Red pine	379,361	2,491	6,730	8,577	40,312	32,630	33,291
White pine	104,078	--	491	--	1,329	10,419	7,950
Balsam fir	679,143	12,674	18,644	31,363	65,442	211,002	193,493
White spruce	49,960	304	384	1,721	4,189	15,454	11,761
Black spruce	493,495	3,624	17,395	32,662	39,987	61,332	101,045
Northern white-cedar	378,567	551	1,833	5,010	10,351	10,892	25,634
Tamarack	203,820	3,117	13,425	9,423	7,848	20,980	40,830
Oak-hickory	784,286	4,577	9,899	2,910	53,113	136,848	133,132
Elm-ash-cottonwood	584,282	9,677	14,165	14,278	18,361	67,374	102,512
Maple-basswood	1,212,875	8,049	14,472	15,438	80,412	173,660	234,623
Aspen	4,681,925	159,232	149,722	250,317	816,553	1,443,009	1,151,136
Paper birch	919,682	5,063	14,592	16,703	95,456	271,439	240,579
Balsam poplar	407,592	13,990	15,138	18,044	64,316	131,327	79,004
Nonstocked	14,590	13,886	151	--	106	348	--
All types	11,453,997	241,916	280,235	430,963	1,413,561	2,729,849	2,502,793

(Table 18 continued)

Forest type	Stand-age class (years)						
	61-70	71-80	81-90	91-100	101-120	121-140	141+
Jack pine	87,204	9,132	12,811	9,533	2,545	--	--
Red pine	19,727	138,196	32,424	62,010	2,973	--	--
White pine	14,846	23,017	4,335	27,989	13,702	--	--
Balsam fir	88,787	29,075	11,850	13,682	3,131	--	--
White spruce	4,956	1,530	3,496	5,173	992	--	--
Black spruce	58,575	73,907	45,927	37,959	8,520	12,562	--
Northern white-cedar	47,916	33,323	55,880	53,773	46,602	84,195	2,607
Tamarack	17,067	17,772	18,679	6,886	29,083	18,204	506
Oak-hickory	138,917	92,210	78,731	82,756	45,926	5,267	--
Elm-ash-cottonwood	92,916	65,691	81,035	63,515	30,253	24,505	--
Maple-basswood	206,122	181,780	93,862	101,704	64,500	38,253	--
Aspen	472,625	144,095	68,134	20,870	3,743	2,489	--
Paper birch	118,869	84,430	51,101	14,231	7,219	--	--
Balsam poplar	46,627	27,224	10,434	1,488	--	--	--
Nonstocked	--	99	--	--	--	--	--
All types	1,415,154	921,481	568,699	501,569	259,189	185,475	3,113

Table 19.--Net volume of sawtimber on commercial forest land by forest type and stand-age class, Minnesota, 1977

(In thousand board feet)[1/]

Forest type	All ages	Stand-age class (years) 0-10	11-20	21-30	31-40	41-50	51-60
Jack pine	1,288,869	9,343	6,218	22,324	199,816	312,645	416,610
Red pine	1,498,128	11,046	11,662	6,336	75,180	98,259	112,932
White pine	491,854	--	3,736	--	3,307	40,202	32,307
Balsam fir	1,250,440	31,237	39,819	55,218	84,935	300,842	368,555
White spruce	133,068	--	--	4,544	6,443	18,527	29,463
Black spruce	404,865	3,928	9,103	13,554	22,714	49,318	86,363
Northern white-cedar	872,938	1,441	2,078	5,006	12,418	21,666	39,144
Tamarack	233,050	2,664	15,628	6,290	4,625	16,338	49,937
Oak-hickory	2,337,948	12,967	28,655	4,203	95,337	221,443	330,599
Elm-ash-cottonwood	1,526,492	13,316	27,471	24,880	38,480	150,895	253,577
Maple-basswood	3,896,085	26,002	29,931	24,429	155,330	348,427	655,637
Aspen	8,336,377	279,718	193,790	285,176	1,006,672	2,267,161	2,393,445
Paper birch	1,473,241	4,202	18,308	25,903	121,683	308,558	337,528
Balsam poplar	829,199	18,472	22,751	11,642	84,769	232,380	183,650
Nonstocked	34,643	32,595	417	--	--	895	--
All types	24,607,197	446,931	409,567	489,505	1,911,709	4,387,556	5,289,747

[1/] International 1/4-inch rule.

(Table 19 continued)

Forest type	Stand-age class (years) 61-70	71-80	81-90	91-100	101-120	121-140	141+
Jack pine	219,381	37,222	32,780	25,228	7,302	--	--
Red pine	81,587	628,588	134,002	325,654	12,882	--	--
White pine	66,361	116,519	16,464	136,463	76,495	--	--
Balsam fir	209,129	68,266	30,755	52,692	8,992	--	--
White spruce	18,619	5,938	16,568	28,260	4,706	--	--
Black spruce	40,053	97,774	40,778	23,422	8,775	9,083	--
Northern white-cedar	78,320	69,199	127,068	102,695	121,903	282,482	9,518
Tamarack	20,194	30,466	24,210	9,891	37,176	15,631	--
Oak-hickory	429,357	317,402	318,135	356,212	200,068	23,570	--
Elm-ash-cottonwood	240,906	195,014	208,672	200,558	79,853	92,870	--
Maple-basswood	732,621	738,672	390,415	353,538	291,066	150,017	--
Aspen	1,175,188	414,623	238,771	64,547	9,726	7,560	--
Paper birch	213,109	207,572	169,931	45,217	21,230	--	--
Balsam poplar	144,776	88,977	36,899	4,883	--	--	--
Nonstocked	--	736	--	--	--	--	--
All types	3,669,601	3,016,968	1,785,448	1,729,260	880,174	581,213	9,518

Table 20.--Net volume of sawtimber on commercial forest land by species and log grade class, Minnesota, 1977

(In thousand board feet)[1/]

Species	All grades	Log grade			
		1	2	3	Tie and timber
SOFTWOODS					
White pine	1,068,372	101,633	146,333	700,974	119,432
Red pine	1,952,896	151,193	186,563	1,542,011	73,129
Jack pine	1,566,444	1,391	53,461	1,495,796	15,796
White spruce	648,730	2,190	17,360	629,034	146
Black spruce	460,401	6,479	14,055	439,789	78
Balsam fir	1,338,249	--	13,261	1,285,687	39,301
Tamarack	346,508	3,957	10,773	331,742	36
Northern white-cedar	1,142,761	17,819	32,446	1,092,496	--
Other softwoods	6,228	10	23	6,195	--
Total	8,530,589	284,672	474,275	7,523,724	247,918
HARDWOODS					
Select white oak	1,076,044	40,767	171,287	608,910	255,080
Select red oak	1,763,622	71,582	331,943	1,091,131	268,966
Other red oak	56,414	1,451	8,001	32,870	14,092
Hickory	32,383	87	6,326	24,428	1,542
Yellow birch	39,926	3,187	9,709	25,601	1,429
Hard maple	489,619	19,152	85,665	349,452	35,350
Soft maple	281,998	17,829	48,707	210,422	5,040
Ash	993,952	47,439	251,585	642,582	52,346
Balsam poplar	1,101,406	29,452	119,818	835,032	117,104
Paper birch	1,234,388	37,102	227,058	859,796	110,432
Bigtooth aspen	303,391	8,453	37,686	235,034	22,218
Quaking aspen	5,671,280	77,940	624,308	4,222,979	746,053
Basswood	1,116,835	139,082	390,695	537,088	49,970
Elm	1,607,307	145,752	514,722	805,432	141,401
Select hardwoods	40,192	1,205	2,695	35,551	741
Other hardwoods	267,851	36,791	35,263	185,293	10,504
Total	16,076,608	677,271	2,865,468	10,701,601	1,832,268
All species	24,607,197	961,943	3,339,743	18,225,325	2,080,186

[1/] International 1/4-inch rule.

Table 21.--Net volume of short-log trees on commercial forest land by species group and diameter class, Minnesota, 1977

(In thousand cubic feet)

Species	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-28.9	29.0-38.9	39.0+
SOFTWOODS											
White pine	1,729	311	85	286	420	89	86	--	366	86	--
Red pine	785	191	265	148	--	109	72	--	--	--	--
Jack pine	4,109	1,685	1,201	843	308	72	--	--	--	--	--
White spruce	264	117	66	--	81	--	--	--	--	--	--
Black spruce	1,208	951	91	--	166	--	--	--	--	--	--
Balsam fir	4,229	2,674	530	141	236	648	--	--	--	--	--
Tamarack	2,462	1,343	887	83	61	88	--	--	--	--	--
Northern white-cedar	11,883	4,538	3,529	1,256	1,115	1,007	267	83	88	--	--
Other softwoods	391	248	--	--	73	--	70	--	--	--	--
Total	27,060	12,058	6,654	2,757	2,460	2,013	495	83	454	86	--
HARDWOODS											
Select white oak	16,071	--	3,734	2,337	3,373	1,761	1,474	1,450	1,322	620	--
Select red oak	13,346	--	2,965	3,523	2,109	1,765	721	1,139	976	148	--
Other red oak	385	--	43	115	--	71	89	67	--	--	--
Hickory	200	--	37	96	--	--	67	--	--	--	--
Yellow birch	2,057	--	176	568	88	211	--	90	924	--	--
Hard maple	10,015	--	1,980	2,855	2,135	861	1,249	248	597	90	--
Soft maple	3,388	--	185	530	428	315	487	178	479	437	349
Ash	5,367	--	2,381	1,244	1,073	354	56	99	114	46	--
Balsam poplar	5,239	--	1,630	1,207	400	1,379	254	225	107	--	37
Paper birch	11,929	--	5,092	2,830	2,578	511	661	134	123	--	--
Bigtooth aspen	3,398	--	1,222	1,100	405	671	--	--	--	--	--
Quaking aspen	60,256	--	26,475	15,301	10,405	5,368	1,900	371	432	4	--
Basswood	7,295	--	2,117	1,452	1,242	588	486	262	1,020	128	--
Elm	15,294	--	3,235	1,865	1,834	1,414	1,513	1,104	2,320	1,377	632
Select hardwoods	489	--	6	83	181	73	--	45	101	--	--
Other hardwoods	2,668	--	540	616	168	204	84	62	283	171	540
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--
Total	157,397	--	51,818	35,722	26,419	15,546	9,041	5,474	8,798	3,021	1,558
All species	184,457	12,058	58,472	38,479	28,879	17,559	9,536	5,557	9,252	3,107	1,558

Table 22.--Net volume of short-log trees on commercial forest land by species group and diameter class, Minnesota, 1977

(In thousand board feet)[1/]

Species	All classes	Diameter class (inches at breast height) 9.0-10.9	11.0-12.9	13.0-14.9	15.0-16.9	17.0-18.9	19.0-20.9	21.0-22.9	23.0-28.9	29.0-38.9	39.0+
SOFTWOODS											
White pine	6,237	1,181	387	1,034	1,792	411	213	--	889	330	--
Red pine	2,874	684	1,246	516	--	254	174	--	--	--	--
Jack pine	14,430	6,339	4,642	2,165	965	319	--	--	--	--	--
White spruce	1,513	754	332	--	427	--	--	--	--	--	--
Black spruce	3,770	3,184	368	--	218	--	--	--	--	--	--
Balsam fir	13,467	8,498	2,168	394	1,337	1,070	--	--	--	--	--
Tamarack	7,773	3,820	2,862	180	455	456	--	--	--	--	--
Northern white-cedar	41,088	17,962	12,155	3,915	2,990	2,794	665	207	400	--	--
Other softwoods	1,716	1,384	--	--	165	--	167	--	--	--	--
Total	92,868	43,806	24,160	8,204	8,349	5,304	1,219	207	1,289	330	--
HARDWOODS											
Select white oak	55,764	--	15,181	8,066	10,936	5,910	4,071	4,460	4,846	2,294	--
Select red oak	40,661	--	10,434	10,694	6,602	4,769	1,717	3,323	2,595	527	--
Other red oak	1,253	--	138	474	--	201	250	190	--	--	--
Hickory	700	--	119	381	--	--	200	--	--	--	--
Yellow birch	4,678	--	556	1,809	177	838	--	435	863	--	--
Hard maple	26,164	--	5,278	7,203	5,308	2,019	2,965	848	2,264	279	--
Soft maple	11,058	--	758	2,426	1,674	1,023	1,443	434	1,145	1,097	1,058
Ash	12,715	--	6,388	3,002	1,924	583	143	193	234	248	--
Balsam poplar	18,654	--	3,957	3,516	867	6,307	1,518	1,489	517	--	483
Paper birch	35,137	--	13,967	8,029	5,595	1,627	4,300	1,024	595	--	--
Bigtooth aspen	8,291	--	2,685	2,654	1,061	1,891	--	--	--	--	--
Quaking aspen	172,196	--	70,814	40,809	33,047	17,143	7,507	1,173	1,700	3	--
Basswood	18,770	--	4,526	2,785	2,515	1,479	1,047	833	4,596	989	--
Elm	58,460	--	13,939	7,758	6,914	5,506	4,379	3,479	8,038	4,944	3,503
Select hardwoods	1,656	--	56	30	743	386	--	203	238	--	--
Other hardwoods	15,221	--	3,327	3,257	1,260	1,089	584	363	912	1,059	3,370
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--
Total	481,378	--	152,123	102,893	78,623	50,771	30,124	18,447	28,543	11,440	8,414
All species	574,246	43,806	176,283	111,097	86,972	56,075	31,343	18,654	29,832	11,770	8,414

[1/] International 1/4-inch rule.

Table 23.--Net annual growth of growing stock on commercial forest land by softwoods and hardwoods, Minnesota, 1962[1/] and 1976

(In thousand cubic feet)

Species	1962	1976
Softwoods	106,789	119,781
Hardwoods	257,420	229,139
All species	364,209	348,920

1/Figures have been adjusted from those published after the 1962 survey to conform to 1977 volumes because of changes in survey definitions and procedures.

Table 24.--Net annual growth of growing stock on commercial forest land by species group and Forest Survey Unit, Minnesota, 1976

(In thousand cubic feet)

Species	All units	Aspen-Birch	Northern Pine	Central Hardwood	Prairie
SOFTWOODS					
White pine	5,599	2,367	2,779	453	--
Red pine	15,684	5,811	8,742	1,113	18
Jack pine	25,677	5,799	19,216	649	13
White spruce	10,701	7,328	3,228	126	19
Black spruce	16,520	11,358	4,947	211	4
Balsam fir	31,902	17,912	13,570	402	18
Tamarack	2,269	(-)343	2,092	508	12
Northern white-cedar	11,274	6,747	4,527	--	--
Other softwoods	155	3	22	100	30
Total	119,781	56,982	59,123	3,562	114
HARDWOODS					
Select white oak	8,733	140	3,213	4,294	1,086
Select red oak	15,691	191	6,034	9,025	441
Other red oak	256	--	29	214	13
Hickory	455	--	12	429	14
Yellow birch	118	30	85	3	--
Hard maple	8,660	1,298	2,535	4,335	492
Soft maple	6,454	1,574	1,813	2,940	127
Ash	9,468	3,996	3,621	1,538	313
Balsam poplar	17,757	6,229	9,429	833	1,266
Paper birch	30,290	10,619	15,829	3,761	81
Bigtooth aspen	1,086	409	341	332	4
Quaking aspen	93,083	31,322	45,739	11,430	4,592
Basswood	17,252	891	6,228	8,516	1,617
Elm	18,022	1,248	5,617	10,307	850
Select hardwoods	440	4	73	306	57
Other hardwoods	1,374	(-)34	71	470	867
Noncommercial species	--	--	--	--	--
Total	229,139	57,917	100,669	58,733	11,820
All species	348,920	114,899	159,792	62,295	11,934

Table 25.--Net annual growth of sawtimber on commercial forest land by species group and Forest Survey Unit, Minnesota, 1976

(In thousand board feet)[1/]

Species	All units	Aspen-Birch	Northern Pine	Central Hardwood	Prairie
SOFTWOODS					
White pine	33,304	15,969	14,775	2,560	--
Red pine	74,768	25,414	48,197	1,064	93
Jack pine	88,650	30,665	56,971	981	33
White spruce	36,750	23,581	12,764	347	58
Black spruce	18,568	14,758	3,800	10	--
Balsam fir	86,053	48,647	36,542	864	--
Tamarack	8,460	6	5,698	2,743	13
Northern white-cedar	33,003	19,486	13,517	--	--
Other softwoods	763	--	664	71	28
Total	380,319	178,526	192,928	8,640	225
HARDWOODS					
Select white oak	30,845	199	9,585	16,546	4,515
Select red oak	61,191	658	19,759	38,201	2,573
Other red oak	960	--	3	909	48
Hickory	1,484	--	6	1,456	22
Yellow birch	612	428	166	18	--
Hard maple	30,649	2,639	6,239	19,508	2,263
Soft maple	18,380	1,574	3,278	10,481	3,047
Ash	18,003	6,377	5,340	5,078	1,208
Balsam poplar	51,922	22,274	25,742	812	3,094
Paper birch	53,434	23,611	26,074	3,715	34
Bigtooth aspen	11,116	1,130	10,651	(-)665	--
Quaking aspen	330,071	132,104	157,084	34,262	6,621
Basswood	48,788	2,452	12,042	27,208	7,086
Elm	61,699	6,113	18,524	34,852	2,210
Select hardwoods	2,261	--	444	1,564	253
Other hardwoods	9,730	(-)19	287	3.358	6,104
Noncommercial species	--	--	--	--	--
Total	731,145	199,540	295,224	197,303	39,078
All species	1,111,464	378,066	488,152	205,943	39,303

[1/]International 1/4-inch rule.

Table 26.--Net annual growth of growing stock on commercial forest land by species group and ownership class, Minnesota, 1976

(In thousand cubic feet)

Species	All owners	Ownership class											
		National Forest	Bureau of Land Mgmt.	Indian	Misc. Federal	State	County & municipal	Forest Industry	Farmer	Misc. priv.-corp.	Misc. priv.-indiv.	Misc. priv.-corp., leased	Misc. priv.-indiv., leased
SOFTWOODS													
White pine	5,599	1,555	27	488	1	382	911	432	1,003	182	581	--	37
Red pine	15,684	6,044	158	630	16	1,582	2,040	1,009	1,565	235	2,405	--	--
Jack pine	25,677	4,407	410	543	387	3,870	4,368	2,911	4,738	960	3,073	10	--
White spruce	10,701	1,965	75	269	85	3,222	1,978	688	1,148	298	960	13	--
Black spruce	16,520	2,827	139	550	98	6,155	3,051	1,232	1,093	509	850	16	--
Balsam fir	31,902	6,364	34	1,350	206	5,974	9,690	1,278	3,728	950	2,317	--	11
Tamarack	2,269	538	11	61	43	340	325	210	(-)175	249	667	--	--
Northern white-cedar	11,274	1,411	131	1,289	47	4,288	1,287	1,112	733	230	746	--	--
Other softwoods	155	--	--	--	--	49	3	--	78	20	5	--	--
Total	119,781	25,111	985	5,180	883	25,862	23,653	8,872	13,911	3,633	11,604	39	48
HARDWOODS													
Select white oak	8,733	178	2	212	32	761	565	45	5,727	196	988	--	27
Select red oak	15,691	388	--	195	109	1,535	1,558	200	6,938	311	4,412	--	45
Other red oak	256	--	--	--	6	29	16	--	193	--	12	--	--
Hickory	455	--	--	8	9	6	4	--	385	--	43	--	--
Yellow birch	118	(-)84	--	--	--	22	94	14	14	18	40	--	--
Hard maple	8,660	208	--	174	54	1,461	631	(-)36	3,984	302	1,874	3	5
Soft maple	6,454	1,104	--	73	409	884	816	140	1,546	177	1,305	--	--
Ash	9,468	2,189	32	404	(-)62	1,434	767	(-)9	2,371	393	1,944	--	5
Balsam poplar	17,757	2,247	201	1,445	502	3,126	2,586	483	4,582	792	1,781	7	5
Paper birch	30,290	2,886	47	788	220	4,433	7,066	1,870	6,458	1,472	5,012	1	37
Bigtooth aspen	1,086	(-)1	7	81	13	1,221	(-)764	(-)525	182	226	639	--	7
Quaking aspen	93,083	15,412	430	4,006	794	19,028	12,866	4,162	19,933	1,267	15,211	(-)64	38
Basswood	17,252	911	--	530	116	1,265	2,383	298	8,012	504	3,165	--	68
Elm	18,022	354	23	451	218	1,717	1,938	385	9,782	474	2,520	--	160
Select hardwoods	440	--	--	--	3	75	20	--	254	21	67	--	--
Other hardwoods	1,374	--	--	1	105	193	4	--	789	40	242	--	--
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	229,139	25,792	742	8,368	2,528	37,190	30,550	7,027	71,150	6,193	39,255	(-)53	397
All species	348,920	50,903	1,727	13,548	3,411	63,052	54,203	15,899	85,061	9,826	50,859	(-)14	445

Table 27.--Net annual growth of sawtimber on commercial forest land by species group and ownership class, Minnesota, 1976

(In thousand board feet)[1/]

Species	All owners	Ownership class											
		National Forest	Bureau of Land Mgmt.	Indian	Misc. Federal	State	County & municipal	Forest Industry	Farmer	Misc. priv.-corp.	Misc. priv.-indiv.	Misc. priv.-corp., leased	Misc. priv.-indiv., leased
SOFTWOODS													
White pine	33,304	12,806	64	2,017	(-)39	1,755	4,177	2,914	5,877	800	2,822	--	111
Red pine	74,768	30,280	932	3,486	109	6,532	12,338	4,638	7,800	902	7,751	--	--
Jack pine	88,650	25,996	1,909	58	400	12,350	12,722	8,228	16,617	746	9,597	27	--
White spruce	36,750	7,226	401	1,130	275	6,373	6,976	1,727	6,183	1,302	5,096	61	--
Black spruce	18,568	9,481	45	113	135	3,183	1,898	1,476	1,624	298	315	--	--
Balsam fir	86,053	21,684	58	1,460	263	15,806	22,240	6,201	9,975	(-)109	8,459	--	16
Tamarack	8,460	1,351	19	82	77	824	1,845	154	389	224	3,495	--	--
Northern white-cedar	33,003	8,653	119	2,113	131	11,372	4,024	2,568	777	1,212	2,034	--	--
Other softwoods	763	--	--	--	--	664	--	--	68	14	17	--	--
Total	380,319	117,477	3,547	10,459	1,351	58,859	66,220	27,906	49,310	5,389	39,586	88	127
HARDWOODS													
Select white oak	30,845	699	8	215	75	1,518	1,496	13	23,298	958	2,463	--	102
Select red oak	61,191	488	--	523	544	5,903	4,033	1,171	33,633	(-)364	15,195	--	65
Other red oak	960	--	--	--	31	53	1	--	840	--	35	--	--
Hickory	1,484	--	--	--	16	8	13	--	1,423	--	24	--	--
Yellow birch	612	154	--	--	--	38	239	42	17	61	61	--	--
Hard maple	30,649	626	--	738	135	2,941	2,380	644	19,894	93	3,198	--	--
Soft maple	18,380	1,171	--	13	1,499	745	464	53	10,497	95	3,843	--	--
Ash	18,003	2,590	35	318	2,423	3,362	3,728	(-)18	1,222	383	3,948	--	12
Balsam poplar	51,922	5,790	711	2,691	99	10,073	13,087	3,484	13,396	842	1,688	33	28
Paper birch	53,434	14,865	5	1,537	673	3,324	7,402	3,732	12,032	963	8,895	--	6
Bigtooth aspen	11,116	1,533	--	832	13	3,015	(-)207	853	1,273	304	3,488	--	12
Quaking aspen	330,071	59,251	1,868	9,001	2,279	52,228	72,551	19,979	55,609	4,690	52,477	64	74
Basswood	48,788	2,433	--	1,155	210	3,231	3,947	1,042	24,661	2,287	9,521	--	301
Elm	61,699	1,858	56	1,269	307	5,307	7,474	1,437	31,136	1,112	11,053	--	690
Select hardwoods	2,261	--	--	--	2	251	--	--	1,863	38	107	--	--
Other hardwoods	9,730	--	--	4	392	262	--	--	7,562	73	1,437	--	--
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--	--	--
Total	731,145	91,458	2,683	18,296	8,698	92,259	116,608	32,432	238,356	11,535	117,433	97	1,290
All species	1,111,464	208,935	6,230	28,755	10,049	151,118	182,828	60,338	287,666	16,924	157,019	185	1,417

[1/] International 1/4-inch rule.

Table 28.--Net annual growth of growing stock on commercial forest land by species group and forest type, Minnesota, 1976

(In thousand cubic feet)

Species	All types	Forest type						
		Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar
SOFTWOODS								
White pine	5,599	119	1,168	1,247	320	35	89	37
Red pine	15,684	1,780	8,797	387	346	42	48	59
Jack pine	25,677	20,768	667	111	172	78	405	87
White spruce	10,701	226	266	267	1,517	1,190	464	34
Black spruce	16,520	438	54	(-)67	2,060	47	11,517	168
Balsam fir	31,902	375	564	(-)532	8,260	188	1,032	169
Tamarack	2,269	5	14	--	129	(-)819	732	84
Northern white-cedar	11,274	--	11	8	1,334	43	376	6,959
Other softwoods	155	--	25	--	--	--	10	--
Total	119,781	23,711	11,566	1,421	14,138	804	14,673	7,597
HARDWOODS								
Select white oak	8,733	31	8	14	18	1	--	--
Select red oak	15,691	94	33	15	4	--	6	--
Other red oak	256	--	--	--	--	--	--	--
Hickory	455	--	--	--	--	--	--	--
Yellow birch	118	--	--	--	7	--	--	15
Hard maple	8,660	--	--	3	19	--	--	--
Soft maple	6,454	146	3	41	44	--	6	1
Ash	9,468	2	6	13	261	(-)310	50	(-)24
Balsam poplar	17,757	33	36	4	(-)819	34	40	198
Paper birch	30,290	495	411	(-)24	2,344	296	239	150
Bigtooth aspen	1.086	(-)576	(-)118	1	14	--	88	10
Quaking aspen	93,083	1,655	(-)30	196	2,261	480	1,143	117
Basswood	17,252	5	--	11	36	--	--	--
Elm	18,022	8	3	--	69	(-)129	6	5
Select hardwoods	440	--	--	--	--	--	--	--
Other hardwoods	1,374	12	4	--	--	--	--	--
Noncommercial species	--	--	--	--	--	--	--	--
Total	229,139	1,905	356	274	4,258	372	1,578	472
All species	348,920	25,616	11,922	1,695	18,396	1,176	16,251	8,069

(Table 28 continued on next page)

(Table 28 continued)

Species	Forest type							
	Tamarack	Oak-hickory	Elm-ash-cottonwood	Maple-basswood	Aspen	Paper birch	Balsam poplar	Non-stocked
SOFTWOODS								
White pine	54	87	53	332	1,558	491	9	--
Red pine	13	245	14	20	3,172	745	16	--
Jack pine	32	252	21	1	2,687	292	22	82
White spruce	52	(-)49	149	318	5,143	816	308	--
Black spruce	840	--	54	(-)17	1,338	(-)4	78	14
Balsam fir	133	30	584	554	14,662	4,339	1,335	209
Tamarack	2,690	4	(-)402	109	(-)240	(-)104	37	30
Northern white-cedar	192	--	882	130	1,107	2	219	11
Other softwoods	--	71	4	28	--	9	8	--
Total	4,006	640	1,359	1,475	29,427	6,586	2,032	346
HARDWOODS								
Select white oak	--	3,983	174	1,311	2,895	245	48	5
Select red oak	7	8,207	348	1,759	4,293	906	19	--
Other red oak	--	172	4	38	38	1	3	--
Hickory	--	363	--	75	--	17	--	--
Yellow birch	--	--	36	20	7	31	2	--
Hard maple	--	390	249	6,464	1,212	269	52	2
Soft maple	14	275	882	1,197	2,914	916	15	--
Ash	16	240	4,202	1,317	2,895	399	385	16
Balsam poplar	121	95	556	(-)293	7,395	616	9,819	(-)78
Paper birch	80	1,486	370	1,669	10,854	11,349	528	43
Bigtooth aspen	--	351	32	(-)88	1,977	(-)618	13	--
Quaking aspen	(-)47	1,033	236	1,609	81,400	921	2,033	76
Basswood	--	1,772	442	11,089	3,315	566	16	--
Elm	86	1,632	2,267	8,762	3,871	762	646	34
Select hardwoods	--	132	26	162	98	16	3	3
Other hardwoods	--	139	933	187	80	--	13	6
Noncommercial species	--	--	--	--	--	--	--	--
Total	277	20,270	10,757	35,278	123,244	16,396	13,595	107
All species	4,283	20,910	12,116	36,753	152,671	22,982	15,627	453

Table 29.--Net annual growth of sawtimber on commercial forest land by species group and forest type, Minnesota, 1976

(In thousand board feet)[1/]

Species	All types	Forest type: Jack pine	Red pine	White pine	Balsam fir	White spruce	Black spruce	Northern white-cedar
SOFTWOODS								
White pine	33,304	356	8,612	9,399	1,653	215	497	255
Red pine	74,768	6,511	40,989	2,353	1,539	104	204	636
Jack pine	88,650	62,359	1,673	215	544	193	3,219	375
White spruce	36,750	365	1,008	2,110	5,639	3,452	897	(-)24
Black spruce	18,568	670	16	30	4,272	23	4,961	(-)188
Balsam fir	86,053	166	2,183	210	19,181	482	2,032	483
Tamarack	8,460	24	10	--	1,201	(-)2,795	2,718	240
Northern white-cedar	33,003	--	36	8	4,679	170	1,674	11,945
Other softwoods	763	--	--	--	--	--	--	--
Total	380,319	70,451	54,527	14,325	38,708	1,844	16,202	13,722
HARDWOODS								
Select white oak	30,845	7	--	13	36	--	--	--
Select red oak	61,191	37	43	62	5	--	--	--
Other red oak	960	--	--	--	--	--	--	--
Hickory	1,484	--	--	--	--	--	--	--
Yellow birch	612	--	--	--	6	--	--	24
Hard maple	30,649	--	--	17	--	--	--	--
Soft maple	18,380	--	--	6	770	--	9	--
Ash	18,003	--	--	9	303	(-)1,516	114	130
Balsam poplar	51,922	42	--	--	1,140	14	22	971
Paper birch	53,434	1,062	1,607	42	3,917	400	33	115
Bigtooth aspen	11,116	26	5	--	24	--	7	10
Quaking aspen	330,071	3,498	1,341	(-)355	6,006	346	2,877	266
Basswood	48,788	--	--	25	88	--	--	--
Elm	61,699	13	--	--	133	(-)520	--	21
Select hardwoods	2,261	--	--	--	--	--	--	--
Other hardwoods	9,730	--	--	--	--	--	--	--
Noncommercial species	--	--	--	--	--	--	--	--
Total	731,145	4,685	2,996	(-)181	12,429	(-)1,276	3,061	1,537
All species	1,111,464	75,136	57,523	14,144	51,136	568	19,264	15,259

(Table 29 continued on next page)

[1/]International 1/4-inch rule.

(Table 29 continued)

Species	Forest type							
	Tamarack	Oak-hickory	Elm-ash-cottonwood	Maple-basswood	Aspen	Paper birch	Balsam poplar	Non-stocked
SOFTWOODS								
White pine	259	445	277	1,667	7,179	2,435	55	--
Red pine	61	765	24	113	17,685	3,705	79	--
Jack pine	50	325	38	(-)18	18,930	629	(-)158	276
White spruce	85	(-)365	883	1,330	15,688	3,970	1,712	--
Black spruce	348	--	38	715	7,318	212	129	24
Balsam fir	173	14	(-)342	6,472	39,017	9,676	5,446	860
Tamarack	7,270	26	(-)632	192	(-)972	650	494	34
Northern white-cedar	1,333	--	3,734	1,111	7,752	(-)58	588	31
Other softwoods	--	69	15	30	--	--	649	--
Total	9,579	1,279	4,035	11,612	112,597	21,219	8,994	1,225
HARDWOODS								
Select white oak	--	13,612	559	7,536	8,107	882	81	12
Select red oak	39	34,649	20	6,967	15,184	4,120	65	--
Other red oak	--	702	23	187	31	--	17	--
Hickory	--	473	--	949	--	62	--	--
Yellow birch	--	--	105	404	7	60	6	--
Hard maple	--	766	215	27,199	1,900	540	12	--
Soft maple	--	1,978	5,668	1,682	8,151	116	--	--
Ash	--	279	7,714	3,970	3,567	1,486	1,915	32
Balsam poplar	141	127	1,109	1,811	18,374	3,315	24,856	--
Paper birch	16	1,152	1,220	4,607	23,456	15,660	138	9
Bigtooth aspen	--	633	51	(-)117	11,700	)1,223	--	--
Quaking aspen	80	5,180	883	5,008	286,167	8,485	10,116	173
Basswood	--	5,328	2,089	36,014	3,989	1,191	64	--
Elm	29	2,575	10,634	28,735	16,165	1,828	1,990	96
Select hardwoods	--	1,681	9	457	81	33	--	--
Other hardwoods	--	146	5,332	4,168	66	--	--	18
Noncommercial species	--	--	--	--	--	--	--	--
Total	305	69,280	35,631	129,578	396,945	36,555	39,260	340
All species	9,884	70,560	39,666	141,189	509,542	57,774	48,254	1,565

Table 30.--Net annual growth of growing stock on commercial forest land by forest type and stand-age class, Minnesota, 1976

(In thousand cubic feet)

Forest type	All ages	Stand-age class (years) 0-10	11-20	21-30	31-40	41-50	51-60
Jack pine	25,616	111	17	3,146	7,134	6,722	5,410
Red pine	11,922	100	836	767	2,331	1,102	1,262
White pine	1,695	(-)29	20	--	88	608	123
Balsam fir	18,396	410	280	1,026	2,883	7,584	3,295
White spruce	1,176	(-)395	30	116	217	(-)94	861
Black spruce	16,251	75	742	1,123	1,369	2,377	3,595
Northern white-cedar	8,069	22	67	137	190	100	855
Tamarack	4,283	103	337	130	322	489	913
Oak-hickory	20,910	43	364	(-)18	1,812	4,911	3,929
Elm-ash-cottonwood	12,116	(-)689	523	500	1,000	2,599	1,935
Maple-basswood	36,753	186	465	907	3,809	5,367	7,969
Aspen	152,671	(-)1,571	7,875	13,982	34,047	46,803	35,933
Paper birch	22,982	110	697	705	2,782	8,228	5,039
Balsam poplar	15,627	397	779	1,520	3,516	4,762	2,258
Nonstocked	453	524	6	--	(-)98	19	--
All types	348,920	(-)603	13,038	24,041	61,402	91,577	73,377

(Table 30 continued)

Forest type	Stand-age class (years) 61-70	71-80	81-90	91-100	101-120	121-140	141+
Jack pine	2,882	284	(-)86	(-)53	49	--	--
Red pine	649	3,084	620	1,089	82	--	--
White pine	479	265	138	(-)210	213	--	--
Balsam fir	2,841	174	(-)370	173	100	--	--
White spruce	191	30	99	101	20	--	--
Black spruce	1,930	2,233	1,313	1,019	94	381	--
Northen white-cedar	1,241	784	1,539	942	618	1,492	82
Tamarak	587	306	(-)309	144	880	369	12
Oak-hikory	3,876	2,574	557	1,809	922	131	--
Elm-ash-cottonwood	1,822	588	1,760	1,131	511	436	--
Maple-basswood	6,685	4,734	2,681	2,306	706	938	--
Aspen	11,096	2,881	1,099	400	65	61	--
Paper birch	2,662	1,797	774	35	153	--	--
Balsam poplar	1,215	822	318	40	--	--	--
Nonstocked	--	2	--	--	--	--	--
All types	38,156	20,558	10,133	8,926	4,413	3,808	94

Table 31.--Net annual growth of sawtimber on commercial forest land by forest type and stand-age class, Minnesota, 1976

(In thousand board feet)[1/]

Forest type	All ages	Stand-age class (years) 0-10	11-20	21-30	31-40	41-50	51-60
Jack pine	75,136	(-)567	719	1,967	15,932	24,704	19,078
Red pine	57,523	360	1,165	372	6,891	4,925	5,904
White pine	14,144	--	131	--	664	1,310	804
Balsam fir	51,136	1,594	455	1,331	5,471	16,623	16,663
White spruce	568	(-)2,036	--	261	198	(-)1,866	981
Black spruce	19,264	94	777	848	1,528	2,797	6,609
Northern white-cedar	15,259	33	48	103	(-)1	(-)696	794
Tamarack	9,884	61	836	166	121	1,965	3,510
Oak-hickory	70,560	(-)152	754	97	3,270	10,004	11,277
Elm-ash-cottonwood	39,666	(-)305	693	1,020	2,027	10,460	3,939
Maple-basswood	141,189	2,116	3,654	(-)276	12,363	13,065	29,692
Aspen	509,542	3,970	15,151	30,531	79,956	166,023	132,793
Paper birch	57,774	182	435	1,455	6,578	19,370	11,100
Balsam poplar	48,254	(-)1,482	341	375	7,199	18,166	9,914
Nonstocked	1,565	1,524	5	--	--	20	--
All types	1,111,464	5,392	25,164	38,250	142,197	286,870	253,058

[1/] International 1/4-inch rule.

(Table 31 continued)

Forest type	Stand-age class (years) 61-70	71-80	81-90	91-100	101-120	121-140	141+
Jack pine	9,840	1,233	986	1,121	123	--	--
Red pine	2,833	20,814	4,892	8,657	710	--	--
White pine	3,019	2,586	444	3,926	1,260	--	--
Balsam fir	5,691	3,255	(-)686	509	230	--	--
White spruce	1,444	117	381	988	100	--	--
Black spruce	1,308	2,631	774	1,603	157	138	--
Northen white-cedar	2,753	2,255	4,595	1,769	143	3,270	193
Tamarack	494	(-)310	1,208	282	1,247	304	--
Oak-hickory	16,819	13,071	1,890	9,428	3,551	551	--
Elm-ash-cottonwood	4,143	5,014	5,752	3,838	1,329	1,756	--
Maple-basswood	21,401	26,144	13,460	9,366	6,039	4,165	--
Aspen	52,045	17,277	9,437	1,778	451	130	--
Paper birch	7,110	5,656	3,857	1,724	307	--	--
Balsam poplar	9,142	2,709	1,361	529	--	--	--
Nonstocked	--	16	--	--	--	--	--
All types	138,042	102,468	48,351	45,518	15,647	10,314	193

Table 32.--Timber removals[1] from growing stock and sawtimber on commercial forest land by species group, Minnesota, 1962 and 1976

Species	Growing stock		Sawtimber	
	[2]1962	1976	[2]1962	1976
	Thousand cubic feet		[3]Thousand board feet	
SOFTWOODS				
White pine	3,620	2,910	20,759	13,190
Red pine	3,416	4,177	15,976	15,214
Jack pine	22,678	21,470	54,844	56,934
Spruce	20,589	17,943	45,600	38,809
Balsam fir	12,601	13,893	20,860	27,000
Tamarack	3,485	4,982	6,305	10,165
Northern white-cedar	2,445	3,315	4,586	8,548
Other	66	110	49	82
Total	68,900	68,800	168,979	169,942
HARDWOODS				
White oak	4,738	5,119	12,763	11,856
Red oak	6,743	10,102	21,149	26,782
Yellow birch	441	16	1,840	41
Hard maple	1,036	1,388	2,534	3,297
Soft maple	1,273	2,840	3,737	5,992
Ash	2,632	5,063	6,781	10,247
Paper birch	3,408	9,113	8,476	13,865
Aspen	45,675	72,979	85,089	172,530
Basswood	2,941	3,529	12,773	10,162
Elm	4,180	7,813	13,872	21,143
Other	3,933	6,838	10,903	14,450
Total	77,000	124,800	179,917	290,365
All species	145,900	193,600	348,896	460,307

[1]/Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

[2]/Figures have been adjusted from those published after the 1962 survey to conform to 1976 volumes because of changes in survey definitions and procedures.

[3]/International 1/4-inch rule.

Table 33.--Timber removals[1/] from growing stock and sawtimber on commercial forest land by item and species category, Minnesota, 1976

Item	Growing stock						Sawtimber					
	All species	Jack pine	Spruce	Other soft-woods	Aspen	Other hard-woods	All species	Jack pine	Spruce	Other soft-woods	Aspen	Other hard-woods
	Thousand cubic feet						[2/]Thousand board feet					
ROUNDWOOD PRODUCTS												
Pulpwood	89,880	13,289	15,188	14,688	42,625	4,090	195,011	26,776	33,977	32,563	99,174	2,521
Saw logs	27,498	5,363	582	4,987	9,006	7,560	135,220	26,743	2,895	27,530	36,805	41,247
Fuelwood	9,065	374	2	135	1,704	6,850	12,683	519	6	195	2,367	9,596
Posts	1,799	723	--	821	20	235	1,206	309	--	347	45	505
Veneer logs	460	--	--	--	65	395	3,059	--	--	--	420	2,639
Poles	610	271	--	339	--	--	1,758	784	--	974	--	--
Other[3/]	5,723	50	--	138	4,607	928	24,986	235	--	729	18,601	5,421
Subtotal	135,035	20,070	15,772	21,108	58,027	20,058	373,923	55,366	36,878	62,338	157,412	61,929
LOGGING RESIDUE	5,060	418	282	457	2,284	1,619	6,954	299	12	519	1,930	4,194
OTHER REMOVALS	53,505	982	1,889	7,822	12,668	30,144	79,430	1,269	1,919	11,342	13,188	51,712
TOTAL	193,600	21,470	17,943	29,387	72,979	51,821	460,307	56,934	38,809	74,199	172,530	117,835

[1/]Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

[2/]International 1/4-inch rule.

[3/]Includes match bolts, particleboard bolts, shavings bolts, piling, lath bolts, etc.

Table 34.--Timber removals[1/] from growing stock on commercial forest land by species group and Forest Survey Unit, Minnesota, 1976

(In thousand cubic feet)

Species	All units	Aspen-Birch	Northern Pine	Central Hardwood	Prairie
SOFTWOODS					
White pine	2,910	1,711	1,013	186	--
Red pine	4,177	1,485	2,540	132	20
Jack pine	21,470	10,718	10,259	484	9
White spruce	4,188	2,888	1,265	20	15
Black spruce	13,755	10,275	3,458	21	1
Balsam fir	13,893	7,728	6,040	119	6
Tamarack	4,982	2,503	2,126	304	49
Northern white-cedar	3,315	1,495	1,801	1	18
Other softwoods	110	--	--	72	38
Total	68,800	38,803	28,502	1,339	156
HARDWOODS					
Select white oak	5,119	10	595	3,136	1,378
Select red oak	9,779	113	1,980	7,255	431
Other red oak	323	--	8	299	16
Hickory	198	--	5	182	11
Yellow birch	16	3	8	5	--
Hard maple	1,388	28	319	813	228
Soft maple	2,840	77	269	2,356	138
Ash	5,063	302	1,237	2,893	631
Balsam poplar	3,078	1,044	1,455	207	372
Paper birch	9,113	3,253	4,540	1,265	55
Bigtooth aspen	3,444	665	2,202	577	--
Quaking aspen	69,535	32,686	30,440	4,965	1,444
Basswood	3,529	48	805	2,000	676
Elm	7,813	207	1,050	4,620	1,936
Select hardwoods	66	--	--	54	12
Other hardwoods	3,496	9	13	2,231	1,243
Noncommercial species	--	--	--	--	--
Total	124,800	38,445	44,926	32,858	8,571
All species	193,600	77,248	73,428	34,197	8,727

[1/]Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

Table 35.--Timber removals[1] from sawtimber on commercial forest land by species group and Forest Survey Unit, Minnesota, 1976

(In thousand board feet)[2]

Species	All units	Aspen-Birch	Northern Pine	Central Hardwood	Prairie
SOFTWOODS					
White pine	13,190	7,641	5,026	523	--
Red pine	15,214	4,210	10,535	405	64
Jack pine	56,934	27,678	27,943	1,296	17
White spruce	12,679	6,368	6,224	54	33
Black spruce	26,130	21,857	4,269	4	--
Balsam fir	27,000	15,329	11,563	108	--
Tamarack	10,165	5,237	4,523	318	87
Northern white-cedar	8,548	4,948	3,568	8	24
Other softwoods	82	--	--	50	32
Total	169,942	93,268	73,651	2,766	257
HARDWOODS					
Select white oak	11,856	10	1,729	7,494	2,623
Select red oak	25,721	160	4,587	20,026	948
Other red oak	1,061	--	10	1,010	41
Hickory	274	--	9	252	13
Yellow birch	41	14	17	10	--
Hard maple	3,297	39	676	2,103	479
Soft maple	5,992	69	558	4,971	394
Ash	10,247	683	3,353	4,861	1,350
Balsam poplar	4,508	1,165	2,522	603	218
Paper birch	13,865	6,582	6,257	1,012	14
Bigtooth aspen	8,797	1,472	5,473	1,852	--
Quaking aspen	163,733	73,787	76,701	12,708	537
Basswood	10,162	152	2,768	5,353	1,889
Elm	21,143	618	4,073	11,371	5,081
Select hardwoods	374	--	--	298	76
Other hardwoods	9,294	7	22	5,312	3,953
Noncommercial species	--	--	--	--	--
Total	290,365	84,758	108,755	79,236	17,616
All species	460,307	178,026	182,406	82,002	17,873

[1]/Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

[2]/International 1/4-inch rule.

Table 36.--Net annual growth and removals[1/] of growing stock on commercial forest land by species group, Minnesota, 1976

(In thousand cubic feet)

Species	Net annual growth	Annual timber removals
SOFTWOODS		
White pine	5,599	2,910
Red pine	15,684	4,177
Jack pine	25,677	21,470
White spruce	10,701	4,188
Black spruce	16,520	13,755
Balsam fir	31,902	13,893
Tamarack	2,269	4,982
Northern white-cedar	11,274	3,315
Other softwoods	155	110
Total	119,781	68,800
HARDWOODS		
Select white oak	8,733	5,119
Select red oak	15,691	9,779
Other red oak	256	323
Hickory	455	198
Yellow birch	118	16
Hard maple	8,660	1,388
Soft maple	6,454	2,840
Ash	9,468	5,063
Balsam poplar	17,757	3,078
Paper birch	30,290	9,113
Bigtooth aspen	1,086	3,444
Quaking aspen	93,083	69,535
Basswood	17,252	3,529
Elm	18,022	7,813
Select hardwoods	440	66
Other hardwoods	1,374	3,496
Noncommercial species	--	--
Total	229,139	124,800
All species	348,920	193,600

[1/]Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

Table 37.--Net annual growth and removals[1] of sawtimber on commercial forest land by species group, Minnesota, 1976

(In thousand board feet)[2]

Species	Net annual growth	Annual timber removals
SOFTWOODS		
White pine	33,304	13,190
Red pine	74,768	15,214
Jack pine	88,650	56,934
White spruce	36,750	12,679
Black spruce	18,568	26,130
Balsam fir	86,053	27,000
Tamarack	8,460	10,165
Northern white-cedar	33,003	8,548
Other softwoods	763	82
Total	380,319	169,942
HARDWOODS		
Select white oak	30,845	11,856
Select red oak	61,191	25,721
Other red oak	960	1,061
Hickory	1,484	274
Yellow birch	612	41
Hard maple	30,649	3,297
Soft maple	18,380	5,992
Ash	18,003	10,247
Balsam poplar	51,922	4,508
Paper birch	53,434	13,865
Bigtooth aspen	11,116	8,797
Quaking aspen	330,071	163,733
Basswood	48,788	10,162
Elm	61,699	21,143
Select hardwoods	2,261	374
Other hardwoods	9,730	9,294
Noncommercial species	--	--
Total	731,145	290,365
All species	1,111,464	460,307

[1]/Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

[2]/International 1/4-inch rule.

Table 38.--Net annual growth and removals[1/] of growing stock on commercial forest land by ownership class and softwoods and hardwoods, Minnesota, 1976

(In thousand cubic feet)

Owner	Net annual growth			Annual timber removals		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
FEDERAL						
National Forest	50,903	25,111	25,792	16,423	7,946	8,477
Other federal	18,686	7,048	11,638	5,202	2,686	2,516
Subtotal	69,589	32,159	37,430	21,625	10,632	10,993
STATE						
Total	63,052	25,862	37,190	34,123	18,920	15,203
COUNTY & MUNICIPAL						
Total	54,203	23,653	30,550	18,354	5,753	12,601
PRIVATE						
Forest industry	15,899	8,872	7,027	15,165	7,491	7,674
Farm and other	146,177	29,235	116,942	104,333	26,004	78,329
Subtotal	162,076	38,107	123,969	119,498	33,495	86,003
ALL OWNERS						
Total	348,920	119,781	229,139	193,600	68,800	124,800

[1/]Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

Table 39.--Net annual growth and removals[1/] of sawtimber on commercial forest land by ownership class and softwoods and hardwoods, Minnesota, 1976

(In thousand board feet)[2/]

Owner	Net annual growth			Annual timber removals		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
FEDERAL						
National Forest	208,935	117,477	91,458	41,631	21,862	19,769
Other federal	45,034	15,357	29,677	12,926	6,839	6,087
Subtotal	253,969	132,834	121,135	54,557	28,701	25,856
STATE						
Total	151,118	58,859	92,259	90,134	52,004	38,130
COUNTY & MUNICIPAL						
Total	182,828	66,220	116,608	46,436	14,769	31,667
PRIVATE						
Forest industry	60,338	27,906	32,432	34,606	16,845	17,761
Farmer and other	463,211	94,500	368,711	234,574	57,623	176,951
Subtotal	523,549	122,406	401,143	269,180	74,468	194,712
ALL OWNERS						
Total	1,111,464	380,319	731,145	460,307	169,942	290,365

[1/]Removals in 1976 are trend-level removals. "Other" removals from the transfer of commercial forest land to productive-reserved are not included in 1976 removals.

[2/]International 1/4-inch rule.

Table 40.--Annual mortality of growing stock and sawtimber on commercial forest land by species group, Minnesota, 1976

Species	Growing stock	Sawtimber
	Thousand cubic feet	Thousand board feet[1/]
SOFTWOODS		
White pine	960	2,994
Red pine	110	345
Jack pine	3,322	6,009
White spruce	1,102	3,408
Black spruce	3,899	1,513
Balsam fir	16,774	21,233
Tamarack	5,857	8,748
Northern white-cedar	1,704	6,212
Other	--	--
Total	33,728	50,462
HARDWOODS		
Select white oak	1,098	3,444
Select red oak	2,993	10,815
Other red oak	--	--
Hickory	--	--
Yellow birch	87	27
Hard maple	1,122	1,003
Soft maple	252	914
Ash	5,071	11,195
Balsam poplar	10,723	17,656
Paper birch	4,870	7,231
Bigtooth aspen	4,841	7,153
Quaking aspen	66,519	110,093
Basswood	1,410	5,043
Elm	8,125	37,957
Select hardwoods	223	--
Other hardwoods	479	--
Noncommercial species	--	--
Total	107,813	212,531
All species	141,541	262,993

[1/] International 1/4-inch rule.

Table 41.--Annual mortality of growing stock on commercial forest land by species group and cause Minnesota, 1976

(In thousand cubic feet)

Species	All causes	Cause									
		Insects	Disease	Fire	Animals	Weather	Suppression	Logging	Timber stand improvement	Land clearing	Unknown and other
SOFTWOODS											
White pine	960	--	762	109	27	27	--	--	--	--	35
Red pine	110	--	--	--	--	59	--	13	--	--	38
Jack pine	3,322	70	1,862	396	143	353	--	12	--	--	486
White spruce	1,102	101	700	--	26	261	--	--	--	--	14
Black spruce	3,899	173	2,390	--	106	618	--	--	--	--	612
Balsam fir	16,774	5,198	6,775	--	76	2,064	19	51	--	45	2,546
Tamarack	5,857	533	1,570	--	86	677	--	--	--	--	2,991
Northern white-cedar	1,704	--	482	--	--	641	--	56	--	--	525
Other softwoods	--	--	--	--	--	--	--	--	--	--	--
Total	33,728	6,075	14,541	505	464	4,700	19	132	--	45	7,247
HARDWOODS											
Select white oak	1,098	--	756	--	--	342	--	--	--	--	--
Select red oak	2,993	--	1,039	--	--	1,032	--	214	--	--	708
Other red oak	--	--	--	--	--	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--	--	--
Yellow birch	87	--	87	--	--	--	--	--	--	--	--
Hard maple	1,122	--	858	--	--	--	--	--	264	--	--
Soft maple	252	--	71	--	--	181	--	--	--	--	--
Ash	5,071	--	1,350	159	--	2,437	--	--	310	--	815
Balsam poplar	10,723	--	5,623	84	784	2,595	--	--	--	--	1,637
Paper birch	4,870	80	3,431	120	--	428	--	53	--	--	758
Bigtooth aspen	4,841	--	2,728	--	--	341	--	--	--	--	1,772
Quaking aspen	66,519	612	42,490	6,817	2,259	10,641	--	277	--	--	3,423
Basswood	1,410	--	232	--	--	959	--	104	--	--	115
Elm	8,125	--	7,446	--	--	--	--	7	129	--	543
Select hardwoods	223	--	223	--	--	--	--	--	--	--	--
Other hardwoods	479	--	--	--	--	207	--	--	--	--	272
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--
Total	107,813	692	66,334	7,180	3,043	19,163	--	655	703	--	10,043
All species	141,541	6,767	80,875	7,685	3,507	23,863	19	787	703	45	17,290

Table 42.--Annual mortality of sawtimber on commercial forest land by species group and cause, Minnesota, 1976

(In thousand board feet)[1/]

Species	All causes	Cause									
		Insects	Disease	Fire	Animals	Weather	Suppression	Logging	Timber stand improvement	Land clearing	Unknown and other
SOFTWOODS											
White pine	2,994	--	1,786	682	193	171	--	--	--	--	162
Red pine	345	--	--	--	--	157	--	--	--	--	188
Jack pine	6,009	344	3,195	421	390	620	--	70	--	--	969
White spruce	3,408	237	1,710	--	60	1,401	--	--	--	--	--
Black spruce	1,513	--	721	--	228	464	--	--	--	--	100
Balsam fir	21,233	7,386	5,302	--	112	3,932	--	143	--	--	4,358
Tamarack	8,748	--	4,372	--	--	--	--	--	--	--	4,376
Northern white-cedar	6,212	--	1,589	--	--	2,434	--	376	--	--	1,813
Other softwoods	--	--	--	--	--	--	--	--	--	--	--
Total	50,462	7,967	18,675	1,103	983	9,179	--	589	--	--	11,966
HARDWOODS											
Select white oak	3,444	--	1,624	--	--	1,820	--	--	--	--	--
Select red oak	10,815	--	4,890	--	--	4,824	--	--	--	--	1,101
Other red oak	--	--	--	--	--	--	--	--	--	--	--
Hickory	--	--	--	--	--	--	--	--	--	--	--
Yellow birch	27	--	27	--	--	--	--	--	--	--	--
Hard maple	1,003	--	1,003	--	--	--	--	--	--	--	--
Soft maple	914	--	8	--	--	906	--	--	--	--	--
Ash	11,195	--	1,469	--	--	8,210	--	--	1,516	--	--
Balsam poplar	17,656	--	9,720	--	--	6,218	--	--	--	--	1,718
Paper birch	7,231	--	4,582	--	--	766	--	293	--	--	1,590
Bigtooth aspen	7,153	--	5,520	--	--	1,633	--	--	--	--	--
Quaking aspen	110,093	--	62,723	8,293	5,410	26,728	--	1,171	--	--	5,768
Basswood	5,043	--	885	--	--	4,158	--	--	--	--	--
Elm	37,957	--	37,437	--	--	--	--	--	520	--	--
Select hardwoods	--	--	--	--	--	--	--	--	--	--	--
Other hardwoods	--	--	--	--	--	--	--	--	--	--	--
Noncommercial species	--	--	--	--	--	--	--	--	--	--	--
Total	212,531	--	129,888	8,293	5,410	55,263	--	1,464	2,036	--	10,177
All species	262,993	7,967	148,563	9,396	6,393	64,442	--	2,053	2,036	--	22,143

[1/] International 1/4-inch rule.

Table 43.--Annual mortality of growing stock and sawtimber on commercial forest land by ownership class and softwoods and hardwoods, Minnesota, 1976

Owner	Growing stock			Sawtimber		
	All species	Softwoods	Hardwoods	All species	Softwoods	Hardwoods
	- - - - Thousand cubic feet- - - -			- - - [1]/Thousand board feet- - - -		
National Forest	14,272	7,505	6,767	9,352	2,426	6,926
Bureau of Land Management	--	--	--	--	--	--
Indian	4,029	1,019	3,010	7,303	1,994	5,309
Miscellaneous federal	861	131	730	1,914	388	1,526
State	20,998	8,772	12,226	35,131	12,350	22,781
County and municipal	31,990	4,477	27,513	51,818	7,623	44,195
Forest industry	12,680	3,534	9,146	18,497	6,419	12,078
Farmer	36,797	4,312	32,485	94,273	10,728	83,545
Farmer owned-leased	--	--	--	--	--	--
Misc. private-corp.	6,213	1,543	4,670	16,586	3,994	12,592
Misc. private-indiv.	13,507	2,435	11,072	28,119	4,540	23,579
Misc. priv.-corp., leased	194	--	194	--	--	--
Misc. priv.-indiv., leased	--	--	--	--	--	--
All owners	141,541	33,728	107,813	262,993	50,462	212,531

[1]/International 1/4-inch rule.

Table 44.--Output of timber products by source of material and softwoods and hardwoods, Minnesota, 1975

Product	Standard units	Total		Roundwood products				Plant byproducts	
				Growing stock		Nongrowing stock			
		No. of units	Thousand cubic feet	No. of units	Thousand cubic feet	No. of units	Thousand cubic feet	No. of units	Thousand cubic feet
PULPWOOD									
Softwood	1/Standard	622,245	49,148	546,506	43,165	31,779	2,510	43,960	3,473
Hardwood	cords	736,607	58,186	591,391	46,715	81,578	6,444	63,638	5,027
Total		1,358,852	107,334	1,137,897	89,880	113,357	8,954	107,598	8,500
FUELWOOD									
Softwood	1/Standard	40,966	2,828	7,551	511	9,677	655	23,738	1,662
Hardwood	cords	301,921	20,885	123,763	8,554	161,057	11,134	17,101	1,197
Total		342,887	23,713	131,314	9,065	170,734	11,789	40,839	2,859
POSTS									
Softwood	Thousand	2,360	1,896	1,921	1,544	439	352	--	--
Hardwood	pieces	421	403	270	255	151	148	--	--
Total		2,781	2,299	2,191	1,799	590	500	--	--
VENEER LOGS									
Softwood	2/Thousand	--	--	--	--	--	--	--	--
Hardwood	board feet	3,216	503	2,946	460	270	43	--	--
Total		3,216	503	2,946	460	270	43	--	--
POLES									
Softwood	Pieces	103,405	618	102,067	610	1,338	8	--	--
Hardwood		--	--	--	--	--	--	--	--
Total		103,405	618	102,067	610	1,338	8	--	--
SAW LOGS									
Softwood	2/Thousand	60,923	11,261	59,144	10,932	1,779	329	--	--
Hardwood	board feet	95,200	16,972	92,917	16,566	2,283	406	--	--
Total		156,123	28,233	152,061	27,498	4,062	735	--	--
OTHER 3/									
Softwood	Thousand	416	416	188	188	2	2	226	226
Hardwood	cubic feet	6,745	6,745	5,535	5,535	393	393	817	817
Total		7,161	7,161	5,723	5,723	395	395	1,043	1,043
ALL PRODUCTS									
Softwood	Thousand	66,167	66,167	56,950	56,950	3,856	3,856	5,361	5,361
Hardwood	cubic feet	103,694	103,694	78,085	78,085	18,568	18,568	7,041	7,041
Total		169,861	169,861	135,035	135,035	22,424	22,424	12,402	12,402

1/Rough-wood, 128 cubic foot basis.

2/International 1/4-inch rule.

3/Other (industrial production) includes match bolts, shaving bolts, particle bolts, lath bolts, piling, etc.

Table 45.--Output of roundwood products by source and softwoods and hardwoods, Minnesota, 1975

(In thousand cubic feet)

Product and species group	All sources	Growing-stock trees			Rough and rotten trees	Salvable dead trees	Other sources
		Total	Sawtimber	Poletimber			
INDUSTRIAL PRODUCTS							
Saw logs							
Softwood	11,261	10,932	10,659	273	10	--	319
Hardwood	16,972	16,566	14,519	2,047	188	--	218
Subtotal	28,233	27,498	25,178	2,320	198	--	537
Veneer logs and bolts							
Softwood	--	--	--	--	--	--	--
Hardwood	503	460	460	--	43	--	--
Subtotal	503	460	460	--	43	--	--
Pulpwood							
Softwood	45,675	43,165	27,609	15,556	446	37	2,027
Hardwood	53,159	46,715	26,549	20,166	4,600	983	861
Subtotal	98,834	89,880	54,158	35,722	5,046	1,020	2,888
Cooperage							
Softwood	--	--	--	--	--	--	--
Hardwood	128	110	110	--	11	--	7
Subtotal	128	110	110	--	11	--	7
Piling							
Softwood	86	86	74	12	--	--	--
Hardwood	--	--	--	--	--	--	--
Subtotal	86	86	74	12	--	--	--
Poles							
Softwood	618	610	570	40	8	--	--
Hardwood	--	--	--	--	--	--	--
Subtotal	618	610	570	40	8	--	--
Mine timbers (Round)							
Softwood	--	--	--	--	--	--	--
Hardwood	--	--	--	--	--	--	--
Subtotal	--	--	--	--	--	--	--
Posts (Round and split)							
Softwood	1,896	1,544	347	1,197	233	59	60
Hardwood	403	255	113	142	74	--	74
Subtotal	2,299	1,799	460	1,339	307	59	134
Other							
Softwood	104	102	92	10	--	--	2
Hardwood	5,800	5,425	4,222	1,203	230	51	94
Subtotal	5,904	5,527	4,314	1,213	230	51	96
All industrial products							
Softwood	59,640	56,439	39,351	17,088	697	96	2,408
Hardwood	76,965	69,531	45,973	23,558	5,146	1,034	1,254
Total	136,605	125,970	85,324	40,646	5,843	1,130	3,662
FUELWOOD							
Softwood	1,166	511	166	345	45	63	547
Hardwood	19,688	8,554	2,786	5,768	831	1,137	9,166
Total	20,854	9,065	2,952	6,113	876	1,200	9,713
ALL PRODUCTS							
Softwood	60,806	56,950	39,517	17,433	742	159	2,955
Hardwood	96,653	78,085	48,759	29,326	5,977	2,171	10,420
Total	157,459	135,035	88,276	46,759	6,719	2,330	13,375

Table 46.--Forest products harvested by ownership class and product, Minnesota, 1975

Ownership class	Pulpwood	Saw logs	Fuelwood	Posts	Poles	Other
	[1] Cords	[2] Thousand board feet	[1] Cords	Thousand pieces	Pieces	Thousand cubic feet
FEDERAL						
National Forest						
Softwood	78,181	9,212	3,439	--	700	27
Hardwood	70,625	3,684	34,096	--	--	1,004
Subtotal	148,806	12,896	37,535	--	700	1,031
Other federal						
Softwood	24,320	2,538	165	108	4,700	3
Hardwood	15,887	2,972	1,995	--	--	38
Subtotal	40,207	5,510	2,160	108	4,700	41
Total	189,013	18,406	39,695	108	5,400	1,072
STATE						
Softwood	172,785	23,420	710	715	29,142	33
Hardwood	122,153	17,275	7,001	2	--	508
Total	294,938	40,695	7,711	717	29,142	541
COUNTY						
Softwood	55,850	5,235	661	80	485	13
Hardwood	122,470	9,608	8,713	--	--	1,016
Total	178,320	14,843	9,374	80	485	1,029
PRIVATE						
Forest industry						
Softwood	86,840	2,581	153	341	--	16
Hardwood	85,748	3,192	499	--	--	350
Subtotal	172,588	5,773	652	341	--	366
Farm and other						
Softwood	160,309	17,937	12,100	1,116	68,378	98
Hardwood	256,086	58,469	232,516	419	--	3,515
Subtotal	416,395	76,406	244,616	1,535	68,378	3,613
Total	588,983	82,179	245,268	1,876	68,378	3,979
ALL OWNERS						
Softwood	578,285	60,923	17,228	2,360	103,405	190
Hardwood	672,969	95,200	284,820	421	--	6,431
Total	1,251,254	156,123	302,048	2,781	103,405	6,621

[1] Rough-wood, 128 cubic foot basis.

[2] International 1/4-inch rule.

Table 47.--Timber products from roundwood by species group and product, Minnesota, 1975

Species	All Products	Saw logs		Veneer logs		Pulpwood	
	[1]Thousand cubic feet	[2]Thousand board feet	[1]Thousand cubic feet	[2]Thousand board feet	[1]Thousand cubic feet	Thousand cords	[1]Thousand cubic feet
SOFTWOODS							
White pine	2,541	11,272	1,943	--	--	7,386	584
Red pine	3,519	10,680	1,840	--	--	10,790	850
Jack pine	21,922	29,058	5,579	--	--	180,543	14,260
Spruce	16566	3,145	605	--	--	202,004	15,956
Balsam fir	10,073	2,100	400	--	--	121,296	9,583
Tamarack	4,620	79	14	--	--	56,266	4,442
Northern white-cedar	1,565	4,589	880	--	--	--	--
Total	60,806	60,923	11,261	--	--	578,285	45,675
HARDWOODS							
White oak	2,498	4,187	695	29	3	--	--
Red oak	7,917	14,355	2,404	751	118	9,703	769
Hickory	29	78	13	--	--	--	--
Yellow birch	23	--	--	20	3	3	--
Hard maple	747	934	153	290	45	200	13
Soft maple	546	781	130	168	25	79	3
Ash	2,639	3,954	683	17	2	55	5
Balsam poplar	1,210	1,269	222	--	--	10,725	848
Paper birch	8,294	2,728	473	190	29	35,474	2,804
Aspen	66,831	49,501	9,166	443	72	615,995	48,660
Basswood	1,042	4,369	758	417	66	--	--
Elm	3,810	9,508	1,665	376	59	733	57
Black walnut	61	236	37	151	24	--	--
Cottonwood	778	3,196	556	358	56	--	--
Other hardwoods	228	104	17	6	1	2	--
Total	96,653	95,200	16,972	3,216	503	672,969	53,159
All species	157,459	156,123	28,233	3,216	503	1,251,254	98,834

(Table 47 continued on next page)

[1]Small quantities may round off to less than 500 cubic feet and will be shown as a dash in columns showing thousand cubic feet.

[2]International 1/4-inch rule.

(Table 47 continued)

Species	Fuelwood		Poles		Posts		Other Products
	Cords	1/ Thousand cubic feet	Pieces	1/ Thousand cubic feet	Thousand pieces	1/ Thousand cubic feet	1/ Thousand cubic feet
SOFTWOODS							
White pine	360	14	--	--	--	--	--
Red pine	519	27	57,284	343	523	419	40
Jack pine	12,353	865	46,121	275	1110	893	50
Spruce	125	5	--	--	--	--	--
Balsam fir	1,338	90	--	--	--	--	--
Tamarack	1,919	126	--	--	49	38	--
Northern white-cedar	614	39	--	--	678	546	100
Total	17,228	1,166	103,405	618	2,360	1,896	190
HARDWOODS							
White oak	21,759	1,509	--	--	233	231	60
Red oak	63,515	4,436	--	--	139	140	50
Hickory	410	16	--	--	--	--	--
Yellow birch	364	20	--	--	--	--	--
Hard maple	7,820	521	--	--	--	--	15
Soft maple	5,805	388	--	--	--	--	--
Ash	28,206	1,945	--	--	11	4	--
Balsam poplar	2,101	140	--	--	3	--	--
Paper birch	61,335	4,276	--	--	--	--	712
Aspen	56,326	3,937	--	--	35	28	4,968
Basswood	2,652	149	--	--	--	--	69
Elm	28,280	1,975	--	--	--	--	54
Black walnut	--	--	--	--	--	--	--
Cottonwood	2,811	166	--	--	--	--	--
Other hardwoods	3,436	210	--	--	--	--	--
Total	284,820	19,688	--	--	421	403	5,928
All species	302,048	20,854	103,405	618	2,781	2,299	6,118

Table 48.--Volume of primary plant residue by kind of material and type of use, Minnesota, 1975

(In thousand cubic feet)

Type of use	Kind of wood residue							
	Total		Coarse[1]		Fine[2]		Bark[3]	
	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood	Softwood	Hardwood
Fiber products[4]	1,127.1	2,968.2	1,015.1	2,797.1	112.0	171.1	--	76.6
Charcoal	57.6	216.2	57.6	216.2	--	--	35.9	100.2
Industrial fuel	1,292.9	161.4	800.7	28.1	492.2	133.3	694.1	404.5
Domestic fuel	368.4	1,034.9	354.4	851.5	14.0	183.4	167.8	423.5
Miscellaneous[5]	167.9	600.9	89.7	51.1	78.2	549.8	14.0	459.2
Not used[6]	1,430.0	2,155.8	494.0	508.1	936.0	1,647.7	1,109.7	2,136.1
Total	4,443.9	7,137.4	2,811.5	4,452.1	1,632.4	2,685.3	2,021.5	3,600.1

[1] Suitable for chipping such as slabs, edgings, veneer cores, etc.

[2] Not suitable for chipping such as sawdust, veneer clippings, etc.

[3] Does not include bark disposal at pulpmills.

[4] For manufacture of pulp, hardboard, or roofing felt.

[5] Livestock bedding, mulch, small dimension, and specialty items.

[6] Includes residue burned as waste.

Table 49.--Removals,[1] net annual growth, and inventory of growing stock on commercial forest land, Minnesota, 1977, and low removals option projections[2] to 2007

(In million cubic feet)

Year	Removals			Growth			Inventory		
	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods
1977	198.4	70.7	127.7	348.9	119.8	229.1	11,454.0	3,477.0	7,977.0
1987	251.8	91.7	160.1	431.7	128.6	303.1	13,229.6	3,923.0	9,306.6
1997	307.6	112.8	194.8	415.7	126.4	289.3	14,698.0	4,174.7	10,523.3
2007	359.8	127.5	232.3	375.3	121.5	253.8	15,287.2	4,205.3	11,081.9

[1] Timber removals includes volume "lost" due to land clearing, flooding, thinning, or changes in land use, in addition to timber cut and used.

[2] Based on the following assumptions: (a) that the overall removals rate will be lower than that for the high removals option; (b) that annual removals rates will differ for each timber product, but that timber removals will increase at an average annual rate of 2.678 percent or 1,893 thousand cubic feet for softwoods and at an average annual rate of 2.730 percent or 3,487 thousand cubic feet for hardwoods; (c) that the total area of commercial forest land will decline at an annual rate of 0.310 percent; (d) that radial growth will decline over time in relation to the increase of basal area per acre of trees; (e) that the intensity of forest management practiced will continue at the rate indicated by recent trends; (f) that the volume of "other" removals will drop during the period as more of these trees are utilized for products.

Table 50.--Removals[1] net annual growth, and inventory of growing stock on commercial forest land, Minnesota, 1977, and high removals option projections[2] to 2007

(In million cubic feet)

Year	Removals			Growth			Inventory		
	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods	All species	Soft-woods	Hard-woods
1977	199.1	71.1	128.0	348.9	119.8	229.1	11,454.0	3,477.0	7,977.0
1987	270.3	98.5	171.8	432.1	128.5	303.6	13,148.8	3,889.8	9,259.0
1997	371.6	132.9	238.7	422.0	126.7	295.3	14,237.4	4,006.8	10,230.6
2007	485.7	166.1	319.6	392.7	122.8	269.9	13,995.4	3,750.2	10,245.2

[1] Timber removals includes volume "lost" due to land clearing, flooding, thinning, or changes in land use, in addition to timber cut and used.

[2] Based on the following assumptions: (a) that the overall removals rate will be higher than that for the low removals option; (b) that annual removals rates will differ for each timber product, but that timber removals will increase at an average annual rate of 4.454 percent or 3,167 thousand cubic feet for softwoods and at an average annual rate of 4.490 percent or 6,387 thousand cubic feet for hardwoods; (c) that the total area of commercial forest land will decline at an annual rate of 0.310 percent; (d) that radial growth will decline over time in relation to the increase of basal area per acre of trees; (e) that the intensity of forest management practiced will continue at the rate indicated by recent trends; (f) that the volume of "other" removals will drop during the period as more of these trees are utilized for products.

Table 51.--Sampling errors[1] for estimates smaller than the State totals of volume, net growth, removals, and area of commercial forest land, Minnesota, 1977

Sampling error	Commercial forest area	Growing Stock			Sawtimber		
		Inventory	Growth	Removals	Inventory	Growth	Removals
Percent	Thousand acres	Million cubic feet			[2] Million board feet		
1	2,131.6	12,460.9	705.6	5,500.0	84,456.1	3,312.4	8,750.1
2	532.9	3,115.2	176.4	1,375.0	21,114.0	828.1	2,187.5
3	237.2	1,385.3	78.4	611.0	9,382.0	368.5	972.2
4	133.2	779.7	44.1	343.7	5,280.8	207.0	546.9
5	85.3	498.4	28.2	220.0	3,378.2	132.5	350.0
10	21.3	124.6	7.1	55.0	844.6	33.1	87.5
15	9.4	55.2	3.1	24.4	375.8	14.6	38.9
20	5.3	31.3	1.8	13.7	211.6	8.3	21.9
25	3.4	19.9	1.2	8.8	135.4	5.3	14.0
50	0.8	5.0	0.3	2.2	33.9	1.3	3.5
100	0.2	1.2	0.1	0.5	8.5	0.3	0.9

[1] At the 68-percent probability level.

[2] International 1/4-inch rule.

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1982. The fourth Minnesota forest inventory: timber volumes and projections of timber supply. U.S. Department of Agriculture Forest Service, Resource Bulletin NC-57, 72 p. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota.

The fourth inventory of Minnesota's forest resources shows a 21-percent increase in growing-stock volume between 1962 and 1977, from 9.4 to 11.5 billion cubic feet. Presented are text and statistics on timber volume, growth, mortality, removals, and future timber supply.

KEY WORDS: Timber resource, statistics, growth, removals, mortality.